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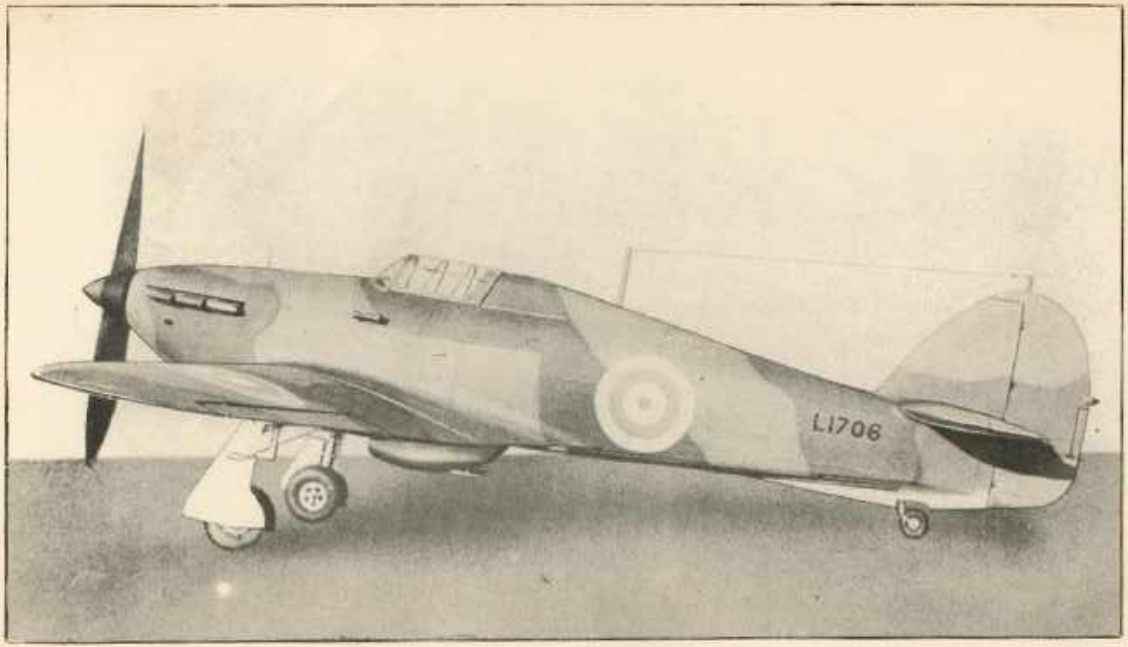
AIR PUBLICATION 1564A

Volume I

S/L. R.A. Jackson

HURRICANE I AEROPLANE
MERLIN II ENGINE

AIR MINISTRY



A.P.1564A, Vol.I Frontispiece
The Hurricane I Aeroplane - Merlin II engine.

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AIR PUBLICATION 1564A
Volume I

THE HURRICANE I

AEROPLANE

MERLIN II ENGINE

This handbook is promulgated for the information and guidance of all concerned.

By Command of the Air Council.

March, 1939

DONALD BANKS

AIR MINISTRY

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AIR PUBLICATION ....

Volume I

Pilot's Notes

AMENDMENT CERTIFICATE

Incorporation of an amendment list in this publication should be certified by inserting the amendment list number, initialling in the appropriate column and inserting the date of incorporation.

Holders of the Pilot's Notes will receive only those amendment lists applicable to the preliminary matter, introduction and sections 1 and 2.

INCORPORATING

Amendt. List No.	1				5	6				
Prelimy. matter					1					
Leading Partics.										
Introducn.										
Section 1										
Section 2	1									
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Prelimy. matter										
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AIR PUBLICATION .....

Volume I

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Amendt. List No.	22									
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Note to official users

Air Ministry Orders and Volume II leaflets as issued from time to time will affect the subject matter of this publication. It should be understood that amendment lists are not always issued to bring the publication into line with the orders or leaflets and it is for holders of this book to arrange the necessary linking-up.

Where an order or leaflet contradicts any portion of this publication, an amendment list will generally be issued, but when this is not done the order or leaflet must be taken as the overriding authority.

LIST OF SECTIONS

(A detailed List of Contents appears at the beginning of each Section or Chapter)

Leading particulars

Introduction

Section 1 - Controls and equipment

" 2 - Handling notes for pilot

" 3 - Maintenance and handling operations

" 4 - Removal and assembly operations

" 5 - Electrical installation

" 6 - Design and construction of airframe

" 7 - Engine installation

Note.- Additional Sections will be issued as and when they are prepared.

LEADING PARTICULARS

Name	Hurricane I
Duty	Day and night fighting
Type	Single-seater, single-engined, low wing land monoplane

Main dimensions

Datum line horizontal unless otherwise stated

Span	40 ft.
Length, overall	31 ft. 5 in.
Height, overall, airscrew vertical	12 ft. 2 in.
Height, overall, airscrew horizontal	11 ft. 10 in.
Height, overall, airscrew vertical, tail down	13 ft. 3 in.
Height, overall, airscrew horizontal, tail down	8 ft. 10 in.
Ground angle, tail down	11½°

Fuselage

Length, overall	28 ft. 6½ in.
Height, maximum	6 ft. 7½ in.
Width, maximum	3 ft. 3½ in.

Outer planes

Aerofoil section - at root	Clark Y.H.19% modified
Aerofoil section - at tip	Clark Y.H.12.5%
Chord at root	6 ft. 0½ in.
Chord at tip, ignoring washout	3 ft. 11½ in.
Incidence (aerofoil to fuselage datum lines)	2° 0' ±30'

Outer planes (contd.)

Dihedral (outer plane datum lines)	3° 30' ± 30'
Sweepback on front spar	3° 0'
Sweepback on leading edge	5° 6'

Centre section

Span (joint pin centres)	9 ft. 1½ in.
Chord	8 ft. 0½ in.
Incidence (aerofoil to fuselage datum lines)	2° 0' ± 30'
Dihedral	Nil
Sweepback	Nil

Tail plane

Span	11 ft. 0 in.
Chord (maximum) including elevator	4 ft. 2½ in.
Incidence (aerofoil to fuselage datum lines)	1° 30' ± 15'
Dihedral	Nil
Sweepback	Nil

Areas

Main plane, with ailerons and flaps	257.6 sq.ft.
Ailerons, total	20.4 sq.ft.
Flaps, total	25.11 sq.ft.
Tail plane, with elevator and trimming flaps	33.26 sq.ft.
Elevator and trimming flaps	13.46 sq.ft.
Tail trimming flaps (two)	0.38 sq.ft. each
Fin	8.83 sq.ft.
Rudder, with balance flap	13.06 sq.ft.
Balance flap	0.36 sq.ft.

Control surfaces, settings and range of movement

Tail plane	Fixed
Fin - leading edge offset to port	1° 30'
Aileron droop	Nil
Aileron movement (from main plane datum line)	22° up 21° down
Elevator	27° up 26° down
Tail trimming flaps	23° up 23° down
Tail trimming flaps, fixed	15° up
Rudder	28° port 28° starboard
Rudder balance flap -	
Inner hole (port and starboard)	28°
Middle hole (port and starboard)	23° 30'
Outer hole (port and starboard)	19° 30'
Flap, centre section	80° 0' down
Flaps, outer planes	80° 0' down
Tolerances on all ranges of movement	±2° 30'

Alighting gear

Undercarriage	
Type	Two separate compression legs and pneumatic wheel units retracting inwards and backwards.
Track	7 ft. 10 in.
Compression legs	
Type	Vickers oleo-pneumatic
Air pressure	See Sect.3, para.22
Wheels -	
Type	Dunlop A.H.2061
Tyres	8 in. for 10 in. wheels
Air pressure	42 lb. per sq.in.

Alighting gear (contd.)

Undercarriage (contd.) -	
Brakes -	
Type	Dunlop pneumatic
Tail wheel unit -	
Type	Compression leg (fixed) with fully castoring pneumatic wheel.
Compression leg -	
Type	Dowty compression coil spring.
Wheel -	
Type	Dunlop A.H.O.5000/IX
Tyre	"Ecta" W.J.11, 4 in. for 3½ in. wheels.
Air pressure	42 lb. per sq.in.

Engine

Name	Merlin II
Type	Supercharged, geared, glycol-cooled, 60°-V engine.
Fuel	Specification D.T.D.230.
Oil	Specification D.T.D.109.
Coolant	Ethylene-glycol (treated) Specification D.T.D.344.

Airscrew

Type	2-bladed wood tractor Drg. No. Z.3895
Diameter	11 ft. 3 in.
Pitch	20 ft. 3 in. (fixed)
Direction of rotation	Right hand, i.e. clockwise when viewed from cockpit.

Tank capacities

Fuel tanks -

Main tanks (two)	Actual 34½ gallons each. Effective 33 gallons each.
Reserve tank (one)	Effective 28 gallons.
Total effective fuel capacity	94 gallons.
Normal quantity of fuel carried	75 gallons.
Oil tank	Actual 10½ gallons. Effective 7½ gallons.

Optimum climbing speeds (A.S.I. reading)

For aeroplanes fitted with 2-bladed wood airscrews to Drg. No. Z.3895 and with kidney type exhaust manifolds, the optimum full throttle indicated climbing speed at sea level and up to 10,000 ft. is constant at 157 m.p.h., A.S.I. reading with a reduction of 1 m.p.h. for each additional 1,000 ft. of altitude.

Note.- The all-up weight of the aeroplane during the tests upon which the above climbing speeds are based was 6,000 lb.

Correction of A.S.I. reading for Position Error

At	80	m.p.h.	A.S.I. reading	add	6.0 m.p.h.
"	100	"	"	"	3.2 "
"	120	"	"	"	0.5 "
"	140	"	"	subtract	1.7 "
"	160	"	"	"	4.0 "
"	180	"	"	"	6.0 "
"	200	"	"	"	7.5 "
"	220	"	"	"	8.7 "
"	240	"	"	"	9.5 "
"	260	"	"	"	9.7 "

Position of pressure head

The pressure head is situated below the port outer plane, the static tube being parallel to the outer plane chord line. The tip of the static tube is 9.55 in. from the underside of the plane and 35.1 in. from the leading edge, the latter dimension being measured parallel to the chord line; on both dimensions there is a tolerance of ± ¼ in.

INTRODUCTION

Note. This Introduction and Sections 1 and 2 are also issued separately as 'Pilots Notes'.

1. The Hurricane I is a single-seater low-wing cantilever land monoplane with retractable undercarriage and enclosed cockpit, designed as a day and night fighter; it is powered with a Merlin II engine which drives a R.H. two-bladed fixed-pitch tractor airscrew. The following are the main dimensions: span, 40 ft.; overall length, 31 ft. 5 in.; overall height with airscrew horizontal and tail down, 8 ft. 10 in.

2. The cockpit is heated indirectly from the radiator circuit and is totally enclosed under a transparent hood which slides towards the rear for entry and exit purposes; the seat is adjustable vertically at any time. An emergency exit panel is provided in the starboard side of the decking and a break-out panel is incorporated in the sliding hood at its port front bottom corner to provide a clear view when landing should the windscreen be covered with ice. Flying controls are of the conventional stick type with a rudder bar which is adjustable horizontally for leg reach; the cockpit is fitted with a normal set of instruments as well as those necessary for instrument flying. A combined oil and coolant radiator is hung beneath the fuselage behind the undercarriage well; it is contained in a low-velocity cowling with a flap shutter hand-operated from the cockpit. Above the longerons, a reserve fuel tank is carried between the fireproof bulkhead and the instrument panel.

3. The main plane is built in three sections, port and starboard outer planes and centre section, the fuselage being recessed to take the centre section so that its underside is flush with the bottom of the fuselage; the centre section is faired into the fuselage. The centre section is of the same construction on all aeroplanes but the outer planes may be either of the fabric-covered or of the skin-stressed type; each type are interchangeable cantilevered units.

4. The main fuel tanks are housed within the centre section between the spars, one tank being fitted on each side of the fuselage; the oil tank forms the port leading edge of the centre section. The mass-balanced ailerons have a differential action and hydraulically-operated split flaps are fitted to the trailing edges of the outer planes and centre section; the flaps extend between the inner ends of the ailerons except in the way of the radiator fairing. Eight Browning guns, together with the necessary ammunition, are housed four aside at the inner ends of the outer planes; the guns fire through the leading edge and are pneumatically controlled from a single button on the control column spade grip. Landing lamps are also mounted in the leading edges of the outer planes, one on each side just outboard of the guns, their positions being controllable from the cockpit.

5. A non-adjustable cantilever tail plane is carried over the rear end of the fuselage; fore-and-aft trimming is obtained by small flaps operated from the cockpit through an irreversible gear mounted within each horn-balanced elevator. The rudder has a small horn balance, which houses the mass-balance weight, and it is fitted with an adjustable balance flap operated automatically from the rudder hinge; the fin is slightly offset to counteract engine and airscrew torque. The tail unit surfaces are faired into the fuselage and into one another, external bracing not being employed.

6. The undercarriage consists of two oleo-pneumatic compression legs which retract inwards and backwards into a well between the centre section spars, the legs being hydraulically-operated and fitted with mechanical locking and electrical indicating devices; an audible warning signal operates when the undercarriage is retracted if the throttle lever is less than one-third open. Each compression leg carries a stub axle with a medium-pressure pneumatic wheel fitted with a pneumatically-operated brake controlled by a lever on the control column; differential action is provided for the brakes and operates in conjunction with the rudder bar. When on the ground, the tail is supported by a non-retractable spring-loaded compression leg which is fully-castoring and self-centering; the leg carries a wheel fitted with a self-earthing tyre.

7. A remotely-controlled transmitter-receiver is situated behind the pilot's seat and behind this instrument, two parachute flares are carried in their launching tubes. Oxygen equipment is also installed and a camera gun (pneumatically-operated from the gun-firing button on the control column) may be mounted on or in, the leading edge of the starboard outer plane. The electrical installation provides for navigation, identification, landing and cockpit lamps, for which power is derived from an engine-driven generator.

SECTION 1

CONTROLS AND EQUIPMENT IN COCKPIT

SECTION 1

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SECTION 1

CONTROLS AND EQUIPMENT IN COCKPIT

General

1. The lay-out of the flying and other controls and equipment is illustrated and annotated in figs. 1 to 4. Each item is given an individual number and where items are referred to in the text the item number is quoted in brackets, e.g. "Mixture control lever (1)". In the majority of instances the controls etc. are of conventional type and these notes are intended only to explain the function and use of those controls and items of equipment the operation of which may not immediately be apparent.

Fuel, oil and coolant

2. The fuel, oil and coolant to be used with the Merlin II engine are:-

Fuel	Specification D.T.D.230
Oil	Specification D.T.D.109
Coolant..	Ethylene-glycol (treated) Specification D.T.D.344

Aeroplane controls

3. Control column.- The spade grip and upper portion of the control column (34) hinges sideways to give aileron control; elevator control is obtained in the normal manner. The spade grip incorporates a gun pneumatic firing button (37) accessible to the left thumb and a bowden brake operating lever (35) accessible to the right hand. For parking, the brakes are applied by gripping the lever with the right hand and operating a retaining catch near the lever pivot with the left hand.

4. Rudder bar.- The rudder bar (31) is of the normal pivoted type, and is adjusteble for leg reach by means of a starwheel (70) which may be operated in flight. Long heel rests are provided.

5. Elevator trimming tabs control.- The trimming tabs are controlled by a handwheel (65) on the left of the seat. An indicator on the left of the handwheel shows the necessary direction of rotation, i.e. rotate forward to correct tail heaviness and vice versa.

6. Undercarriage and flap (hydraulic) controls.- These consist of a selector lever (72), an engine pump control lever (73) and a hand pump lever (77). The selector lever is situated to the right front of the seat and works in a gate. It has a central neutral position and four working positions, i.e. "Up" and "Down" for both undercarriage units and flaps, the flap positions being outboard. The engine pump lever is situated outboard of the selector. The hand pump lever is on the right of the seat; it is cranked and fitted with a rubber grip.

7. The method of operation is to move the selector to the position required and then either depress the engine pump lever until the selected operation is completed, or work the hand pump lever until the same result is obtained. To obviate inadvertent selection on the ground of undercarriage "Up", a safety catch is provided. The catch is a swinging plate which, when in use, covers the slot of the gate and prevents entry of the lever.

8. Undercarriage indicator.- The up and down positions of the undercarriage units are indicated separately by red and green lamps respectively. The lamps are duplicated and contained in an indicator (13) on the port side of the instrument panel. Two switches (12) on the left of the indicator control the lamps, that on the left being the main switch and that on the right the change-over switch for the duplicate set of lamps. The duplicate lamps are for use should it be suspected that any of the lamps normally used have failed.

9. Undercarriage warning buzzer.- Should the undercarriage units not be locked "Down" at any time when the throttle lever is less than one-third open, the pilot will immediately be warned by the sounding of a buzzer (6) situated close to his head on the port side of the cockpit. This device may be tested on the ground by raising by hand one of the undercarriage side stay latch locks whilst the throttle is less than one-third open.

10. EMERGENCY CONTROL - Undercarriage releases.- A separate foot-operated button release (71) painted red, situated outboard of each heel rest, is provided to unlock each of the undercarriage units in the event of the failure or stretching of the snap lock operating cable coupled to the hydraulic selector lever.

11. Flap indicator.- A mechanical indicator (75) situated to the right-hand side of the seat, directly below the hydraulic selector, shows the setting of the flaps. The indicator pointer moves along a graduated scale marked "Up" and "Down" at its extremities.

Engine controls

12. Mixture control lever.- The automatic mixture control lever (1) has two positions only i.e. "Rich" and "Weak"; there are no intermediate positions. The adjustment of the mixture strength to meet the varying conditions of altitude is effected by the automatic unit on the engine. The mixture control lever is returned to the "Rich" position by the closing movement of the throttle control lever.

13. Engine controls friction adjustment.- In order to prevent movement due to vibration the mixture and throttle levers are separately governed by friction adjusters (39 and 40) on the inboard side of the lever spindles. The knurled wheel controls the mixture lever and the larger serrated wheel the throttle.

14. Radiator flap control.- The flap controlling the air-flow through the coolant and oil radiators is governed by a long hand lever (67) on the left side of the seat. The lever is released for movement by pressure on a thumb button in the end. A mechanical indicator (64) showing the radiator flap setting is situated on a structure tube just forward of the elevator trimming tab handwheel.

15. EMERGENCY CONTROL - Cut-out for automatic boost.- This is situated on the port side of the instrument panel. It consists of a red-painted knob (5) and is pulled out to operate and locked by a clockwise turn. It is intended for use should the automatic boost control fail in flight or should it be necessary in an emergency to override the automatic control for increase of boost.

Seating and exits

16. Seat control.- The seat is adjusted for height by movement of a long lever (74) on the right of the seat. The locking device is released by depressing a thumb pressbutton in the end of the lever.

17. Safety belt release control.- A bowden control lever similar to that for locking the cockpit hood is provided on the starboard longeron to release and relock the safety belt shoulder straps. To relock the straps the pilot should lean fully back before operating the lever.

18. Cockpit hood locking control.- The cockpit hood slides fore and aft and can be locked in either the closed or open position by means of a bowden control lever (58) on the port longeron just aft of the engine controls. The hood is unlocked when the control lever is in the down position.

19. EMERGENCY CONTROL - Exit panel.- A large detachable panel on the starboard side, dowelled at the bottom to the decking shelf and held fore and aft at the top by spring-loaded plungers, is controlled by a single lever on the inside of the panel. The panel is instantly freed by moving the lever backwards and upwards to the "Open" position, BUT THE LEVER CANNOT BE OPERATED UNLESS THE COCKPIT HOOD IS MOVED TO ITS FULLY-OPEN POSITION.

Operational equipment

20. Fuel contents gauge.- A single gauge (42) on the starboard side of the instrument panel indicates selectively the contents of each of the three tanks - two main and one reserve. A selector arm and pushbutton switch unit (43) is located above the gauge. The gauge is operated by moving the selector arm to the required position and then pushing the switch button. The gauge scale has upper and lower graduations, the former indicating for the reserve tank and the latter for either of the main tanks.

21. It should be noted that when the aeroplane is on the ground the gauge readings are not correct. A conversion table showing the actual contents of the reserve and main tanks in relation to tail-down readings is fixed to the exit panel on the starboard side of the cockpit.

22. Oxygen equipment.- A single oxygen cylinder is stowed behind the seat. A standard regulator unit (10) is fitted on the port side of the instrument panel and a bayonet union socket (59) for the low-pressure supply to the mask is located on the decking shelf alongside the port longeron.

23. R/T remote controls.- A standard controller (60) is fitted on the port side of the cockpit hooding above the engine controls. The upper lever of the controller, which operates the change-over switch of the transmitter-receiver, is pushed forward for "Receive" and pulled back for "Send"; the wireless unit is switched off by moving the lever to the vertical or "Off" position. The lower lever, which operates the tuning circuit of the receiver is pre-set before taking off but can subsequently be used for any fine tuning adjustments that may be necessary. The serrated central knob on the controller is a remote volume-control; it is turned clockwise to increase the volume and vice versa. A switch unit clipped to a diagonal structure member, just forward of the trimmer control handwheel, is provided for the purpose of connecting a time switch to the wireless unit. The combined microphone and telephone socket (66) is fixed to the front edge of the seat.

24. Parachute flares release controls.- A toggle release (76) for each of the port and starboard parachute flares is located outboard and below the flap setting indicator. The toggle pulls work through an indicator plate and are pulled upwards to release the flares.

25. Landing lamp control.- A two-way switch (3) on the decking shelf at the extreme port corner of the instrument panel enables either the port or the starboard landing lamp to be used as required; both lamps are off when the switch knob is upright. A bowden dipping control (61) is situated immediately aft of the engine control levers; the lamps are dipped by pushing the lever forward and the lever can be held in any position by tightening the knurled wheel provided. When the knurled wheel is unscrewed the lever is pulled aft into the "Up" position by a return spring in each of the lamp units.

Flying control locking gear and picketing rings

26. Flying control locking gear.- This gear is contained in a canvas bag stowed in a locker behind the pilot's head. The locking gear comprises a hinged bracket for attachment to the control column, a pair of tubes which lock the rudder bar to the column bracket and a telescopic interference tube connected to the column bracket and passed through the slot in the back of the seat. The bracket is fastened round the top of the lower portion of the column by a toggle screw and is positioned with its projecting lugs embracing the aileron actuating tie-rods and in contact with the tie-rod fork-end nuts; thus, movement of the hinged top portion of the column, and hence the ailerons, is prevented.

27. The rudder bar locking tubes are pinned to the column bracket and provided with quick-attachment ends for connection to spigot bolts clipped to the rudder bar. The telescopic interference tube prevents occupation of the seat whilst the controls are locked.

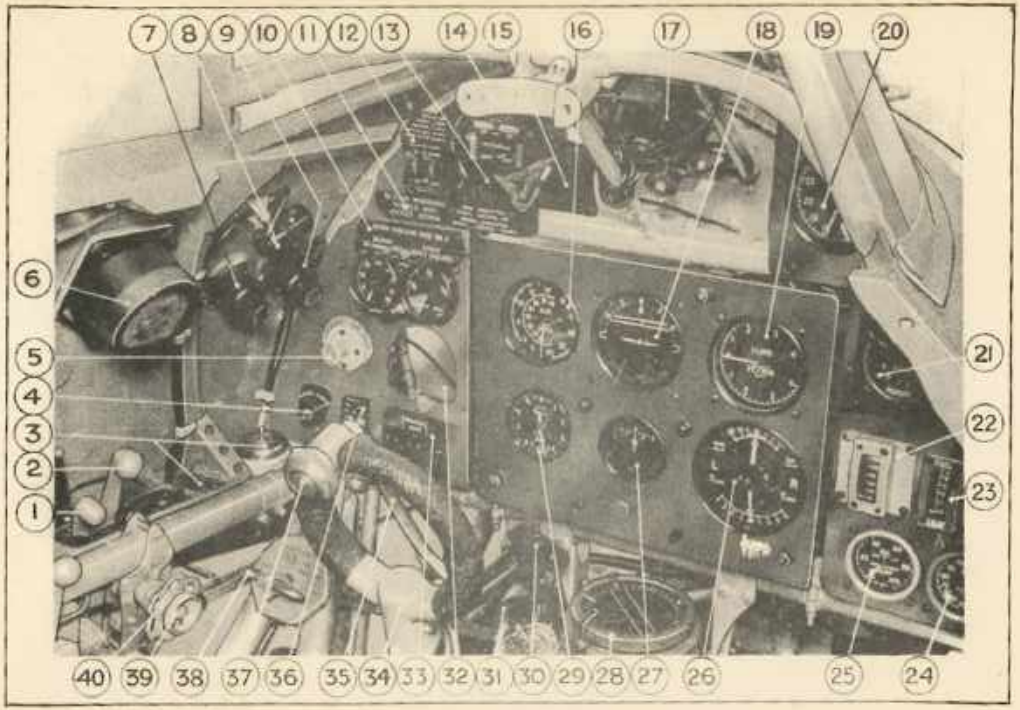
28. Picketing rings.- A pair of picketing rings, contained in a pocket of the locking gear bag, are provided for attachment to screwed sockets on the under-surface of the wing spars just inboard of the wing tip.

Miscellaneous equipment

29. First-aid outfit.- This is attached by means of elastic cords to the inside of a detachable fairing panel on the port side aft of the cockpit. In case of emergency this panel must be kicked in, breaking the stringers and tearing the fabric. The position of the outfit is clearly indicated on the fuselage covering.

30. Map case.- A metal case for maps, books, etc. is fixed to the front of the exit panel on the starboard side of the cockpit. A canvas stowage case for the course and height indicator is fixed to the face of the map case.

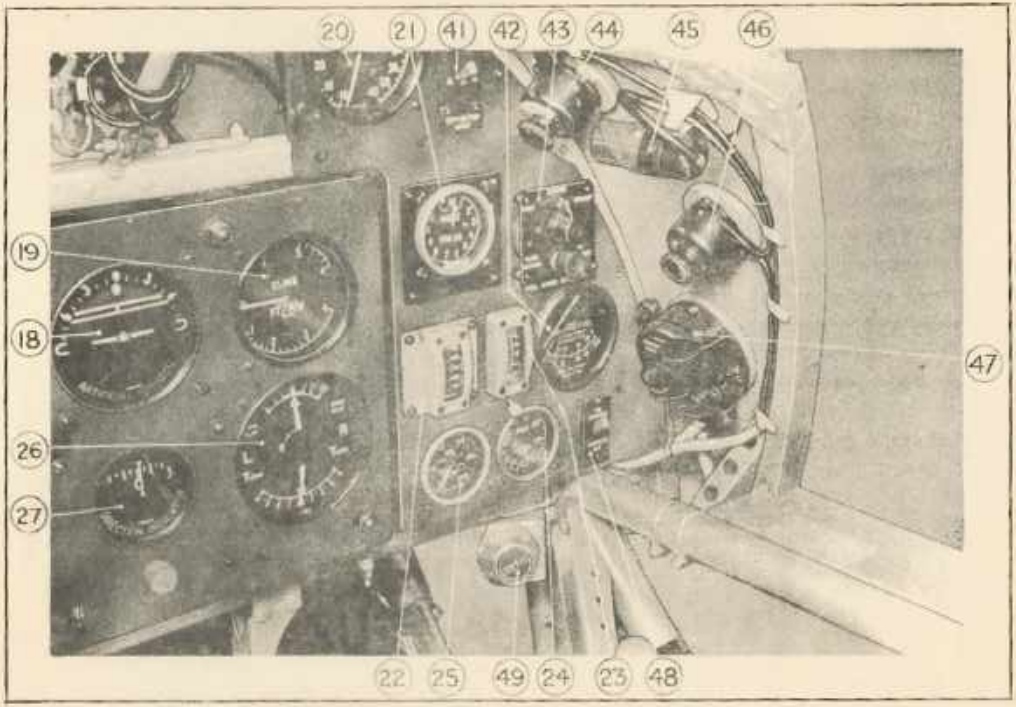
31. Engine starting handles.- Two starting handles are stowed in the undercarriage wheel recess beneath the centre section, one on each side wall. To remove a handle, unscrew the wing nut on the securing bracket and swing the bolt downwards; then lift the clip, disengage the starting handle and withdraw it forwards.



Instrument panel, port side. A.P.1564A, Vol.I, Sect.1, Fig.1.

Index to items on fig.1

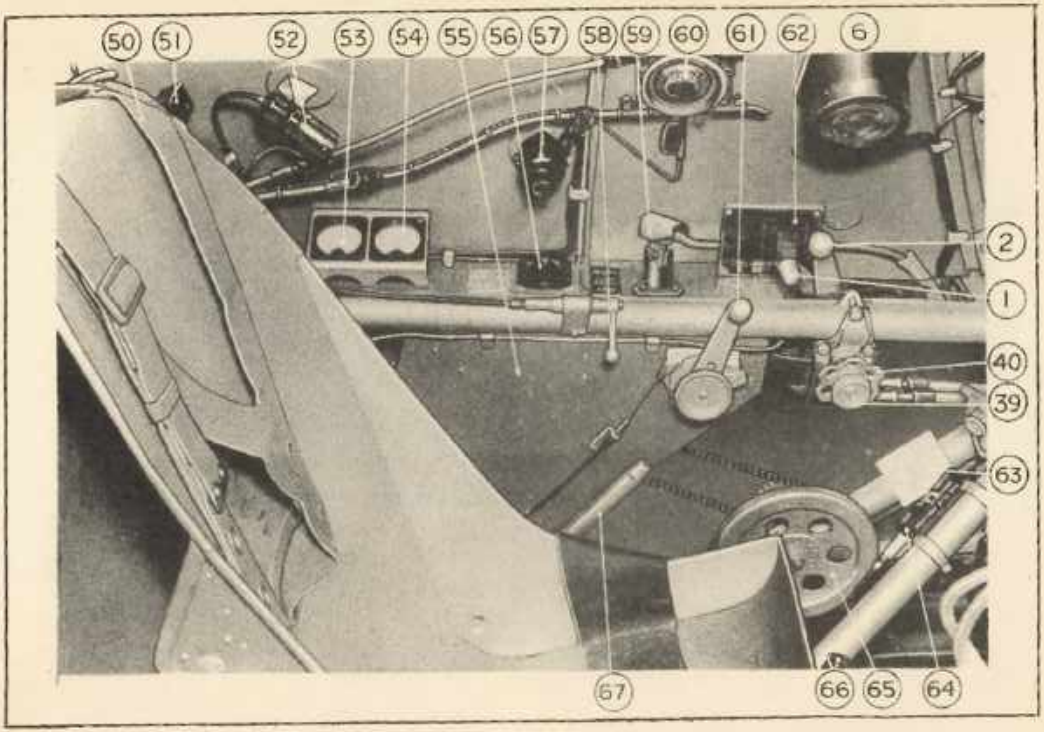
1 Mixture control lever.
2 Throttle control lever.
3 Landing lamp switch and instruction plate.
4 Electric starter push button
5 Automatic boost EMERGENCY cut-out control. PULL to operate.
6 Undercarriage warning buzzer.
7 Dimmer switch for (8).
8 Cockpit floodlamp.
9 Dimmer switch for (30,.
10 Oxygen regulator.
11 Undercarriage buzzer warning plate.
12 Undercarriage indicator lamps switches.
13 Undercarriage indicator lamps.
14 Head protector pad mounting.
15 Compass correction card holder.
16 A.S.I.
17 Reflector sight dazzle screen.
18 Artificial horizon.
19 Rate of climb indicator.
20 Engine speed indicator.
21 Boost pressure gauge.
22 Oil pressure gauge.
23 Fuel pressure gauge.
24 Radiator temperature gauge.
25 Oil temperature gauge.
26 Turn indicator.
27 Direction indicator.
28 Compass.
29 Altimeter.
30 Cockpit floodlamp.
31 Rudder pedal.
32 Clock.
33 Navigation lamps switches.
34 Control column.
35 Brake control lever.
36 Main magneto switches.
37 Gun firing button.
38 Fuel control cock.
39 Mixture lever friction adjuster.
40 Throttle lever friction adjuster



Instrument panel, starboard side. A.P.1564A, Vol.I, Sect.1, Fig.2.

Index to items on fig.2

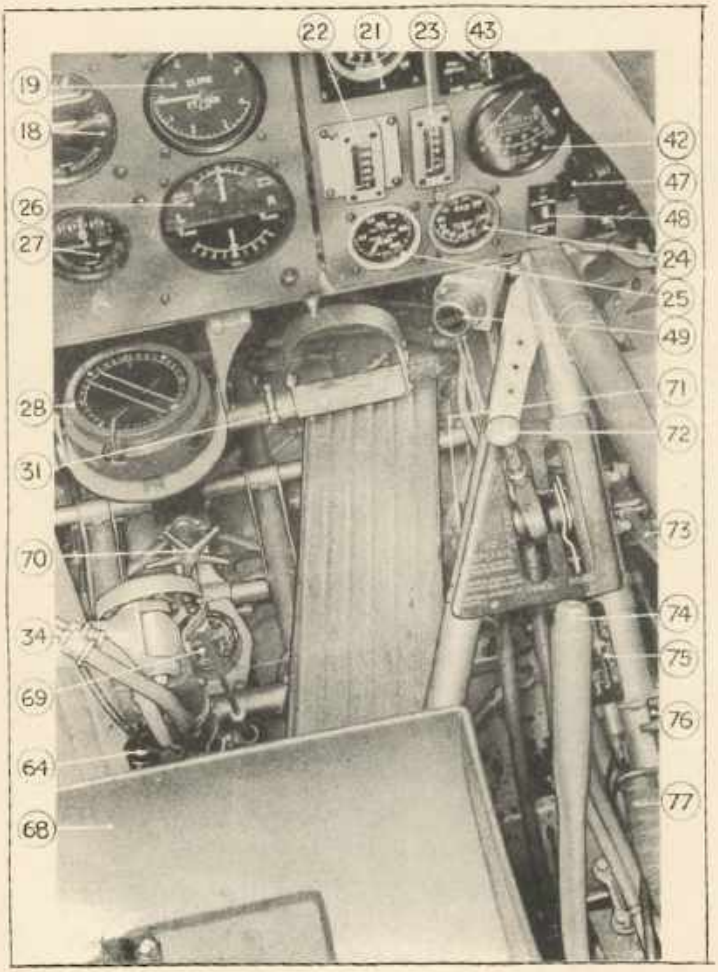
18 Artificial horizon.
19 Rate of climb indicator.
20 Engine speed indicator.
21 Boost pressure gauge.
22 Oil pressure gauge.
23 Fuel pressure gauge.
24 Radiator temperature gauge.
25 Oil temperature gauge.
26 Turn indicator.
27 Direction indicator.
41 Reflector sight lamp switch.
42 Fuel contents gauge - reserve and main.
43 Fuel contents gauge selector switch and pushbutton.
44 Dimmer switch for reflector sight lamp.
45 Cockpit floodlamp.
46 Dimmer switch for (45).
47 Identification lamps switchbox.
48 Starting magneto switch.
49 Primer pump.



Port side of cockpit. A.P.1564A, Vol.I, Sect.1, Fig.3.

Index to items on fig.3

1 Mixture control lever.
2 Throttle control lever.
6 Undercarriage warning buzzer.
39 Mixture lever friction adjuster.
40 Throttle lever friction adjuster.
50 Safety belt.
51 Terminal block for R/T wiring.
52 Cockpit floodlamp.
53 Voltmeter.
54 Ammeter.
55 Electrical fuse panel (fuses etc. on reverse side).
56 Generator charge-regulating switch.
57 Dimmer switch for (52).
58 Hood catch lever.
59 Oxygen supply bayonet socket.
60 R/T remote controller.
61 Landing lamps control lever.
62 Engine data plate.
63 Switch unit for contactor.
64 Radiator flap indicator.
65 Elevator trimming tabs control handwheel.
66 Microphone socket.
67 Radiator flap control lever.



Starboard side of cockpit. A.P.1564A, Vol.I, Sect.1, Fig.4.

Index to items on fig.4

18 Artificial horizon.
19 Rate of climb indicator.
21 Boost pressure gauge.
22 Oil pressure gauge.
23 Fuel pressure gauge.
24 Radiator temperature gauge.
25 Oil temperature gauge.
26 Turn indicator.
27 Direction indicator.
28 Compass.
31 Rudder pedal
34 Control column.
42 Fuel contents gauge - reserve and main.
43 Fuel contents gauge selector switch and pushbutton.
47 Identification lamps switchbox.
48 Starting magneto switch.
49 Primer pump.
66 Microphone socket.
68 Seat
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70 Rudder bar adjusting starwheel.
71 Starboard undercarriage EMERGENCY release (foot operation).
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73 Hydraulic engine pump control lever.
74 Seat raising lever.
75 Flaps indicator.
76 Parachute flares release controls.
77 Hydraulic hand pump lever.

SECTION 2

HANDLING NOTES FOR PILOT

SECTION 2

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SECTION 2

HANDLING NOTES FOR PILOT

Preparation for flight

1. The Hurricane may be flown with or without guns, ammunition or R/T equipment.

Preliminaries

2. On entering the cockpit proceed as follows:-

(i) Switch on the undercarriage indicator lamps (port switch) when two green lights should show.

(ii) Ascertain that the safety catch of the hydraulic selector is covering the chassis "Up" position.

(iii) Open radiator flap; during cold weather the flap should be kept closed until the coolant temperature commences to rise.

(iv) Check movement of flying controls.

(v) Check throttle lever friction adjustment. The larger serrated hand adjuster should be set to hold the lever firmly to prevent it working back during "take-off".

Starting the engine

Note.- For full particulars of the Merlin II engine see A.P.1590B, Volume I, 2nd Edition.

3. For starting purposes the engine must always be supplied from the reserve tank as this provides a gravity feed, and the main or wing tanks, being below the level of the engine, deliver fuel only when the engine is running. It is important to note that the run-up and take-off must be made on reserve supply if the main tanks are less than half full. Therefore a decision must be made, prior to running-up, as to which supply is to be used for the take-off. The supply having been chosen, the fuel distributor cock must not again be moved until the take-off has been accomplished, as such movement may disturb the flow and cause a stoppage.

IMPORTANT. To obviate any danger of air locks in the fuel system, with consequent engine failure, the reserve (gravity) tank must not be exhausted completely before switching over to the main tanks. To prevent temporary stoppage of the engine, it is preferable not to empty completely the main tanks before switching over to the reserve tank.

To start the engine proceed as follows:-

(i) Check contents of fuel tanks and decide which supply is to be used for run-up and take-off.

(ii) Turn the fuel distributor cock to "Reserve".

(iii) Move the throttle lever forward about ½ in. on the quadrant.

(iv) With a cold engine give four to five strokes of the primer pump. It is most important to avoid over-priming when the engine is hot; in this instance a start should be tried without priming at all, then if the engine fails to start give one or two strokes only of the primer pump.

(v) Ensure that all personnel are clear of the airscrew.

(vi) Switch on main and starting magneto switches.

(vii) Press starting switch or commence hand starting. The electric starter should not be used continuously for periods of more than 30 seconds.

(viii) If the engine fails to start immediately, one or two additional strokes of the primer pump should be given; this number should not be exceeded.

(ix) As soon as the engine has started, switch off the starting magneto. Turn the fuel distributor cock to the "Main Tanks" position and so test the engine fuel pumps for satisfactory working. If the run-up and take-off are to be made on the reserve tank supply, turn the fuel cock to "Reserve" and leave in this position until the take-off has been completed.

(x) Warm up the engine until the inlet oil temperature is at least 15°C, and the coolant temperature is not less than 70°C, before opening up to full throttle. Care should be taken whilst warming up to find a throttle position where the engine will not be running rich and will be firing as evenly as possible. For the first three minutes the engine should be warmed up at a fast tick-over and then opened up to about 1,100 r.p.m. until the above temperatures are obtained.

Checking engine and installation

4. The throttle may be opened fully only for the shortest periods necessary for the checks to be made.

Check the following:-

<u>During warming-up</u>

(i) Check fuel pressures:-

Main tanks	.. ..	1½ - 2 lb./sq.in.
Reserve tank	.. ..	2½ - 3 lb./sq.in.

(ii) Check operation of hydraulic engine pump. This can be done by operating the flaps; select "Flaps down" and depress the operating lever.

(iii) Check the hydraulic handpump by returning the flaps to the "Up" position by means of the handpump; afterwards select neutral.

During running-up

(iv) Static r.p.m: 2,100 - 2,200

(v) Static boost: + 6 lb./sq.in. (approx.)

(vi) Oil pressure: a pressure of 70 - 95 lb./sq.in. will be obtained initially and will fall to the normal pressure of 60 lb./sq.in. as the oil temperature rises to its normal value.

(vii) Check magnetos: normal drop 80 r.p.m.

(viii) Check pressure in air cylinder of brakes system; minimum for taxying 100 lb./sq.in.

Preparation before take-off

5. Prior to taxying out for take-off proceed as follows:-

(i) Set the elevator trimming tab for take-off, i.e. with indicator in the central position.

(ii) Depress flaps 28° (two divisions on indicator).

(iii) Move the safety catch of hydraulic selector gate to uncover the "Up" position for undercarriage lever.

(iv) See that the pilot's cockpit hood is fully opened (A.M.O.A.250/37) and locked in this position.

Taxying-out

6. Before opening up the engine for taxying see that the brake parking catch is released. Taxying is normal and the brakes can be used with confidence. During prolonged taxying check air pressure for brakes.

Delay prior to take-off

7. If the take-off has been delayed for any reason, the engine should be cleared by opening it up against the brakes. Whilst doing this the wheels or brakes may slip slightly, but the tail will not lift if the elevator control is held back fully.

Take-off

8. The flaps should be positioned down two divisions (28° approximately.) If there is ample room for the take-off the flaps may be left in the "Up" position, in which case a further run of 90 to 120 yards on the ground may be expected. The aeroplane should be taken off at full throttle with the mixture control at "Rich"; the throttle is not gated. For the take-off the following points should be noted:-

(i) A firm push on the control column is required to raise the tail; the tail should be well lifted.

(ii) Attempts must not be made to pull the aeroplane off the ground until an A.S.I. reading of 80 m.p.h. has been attained.

(iii) As soon as the aeroplane is well clear of the ground, raise the undercarriage. Select wheels "Up" and press the operating lever firmly until both red lights appear.

(iv) If the take-off has been made with flaps down, select flaps "Up" and again press the operating lever until the flap indicator shows fully "Up". The flaps should not be raised until a safe altitude is reached and not below 90 m.p.h. A.S.I. reading.

(v) If the take-off has been made with the fuel supply from the reserve tank, the fuel distributor cock should be moved to the "Main tanks" position as soon as a safe height has been attained.

Precaution after take-off

9. As a safeguard in the event of the engine failing following the take-off, a steep angle of climb should not be attempted. It is preferable to aim at clearing the aerodrome boundary by a small margin.

Climbing

10. For aeroplanes fitted with 2-bladed wood airscrews to Drg. No.2.3895 and with kidney type exhaust manifolds, the optimum full throttle indicated climbing speed at sea level and up to 10,000 ft. is constant at 157 m.p.h. A.S.I. reading with a reduction of 1 m.p.h. for each additional 1,000 ft. of altitude. The radiator flap should be set in the fully open position for climbing, except at high altitudes or when the coolant temperature falls below 70°C.

Note.- The all-up weight of the aeroplane during the tests upon which the above climbing speeds are based was 6,000 lb.

Cruising

11. For continuous cruising the boost pressure must not exceed + 4½ lb./sq.in. at 2,600 r.p.m. The mixture control must be in the "Rich" position at all boost pressures in excess of + 2½ lb./sq.in. and the r.p.m. must not exceed 2,600.

Economical cruising with the mixture control in the "Weak" position can be employed at any altitude with a boost pressure of less than + 2½ lb./sq.in. The mixture control must be returned to the "Rich" position when the boost exceeds + 2½ lb./sq.in. It should be noted that under economical cruising conditions the engine does not respond readily to the throttle and this may be improved by returning the mixture control temporarily to the "Rich" position.

Gliding

12. With flaps and undercarriage down a good average gliding speed is 80 m.p.h. A.S.I. reading with the engine running slightly faster than idling speed. For gliding turns with engine idling, 90 A.S.I. reading provides a safe margin.

Approach

13. The normal method of approaching to land is by means of a straight glide, (at the speeds mentioned above) with the use of some engine until the aerodrome boundary is passed. Note the following:-

(i) Prior to the approach, reduce speed to about 150 m.p.h., A.S.I. reading, and lock the cockpit hood in the open position; select wheels "Down" and press the operating lever (or operate the hand pump); keep the lever depressed until the green lamps light, indicating that the wheels are locked down and safe for landing. If the hand pump is used (see para.14), pumping must be continued until increased resistance is felt and the green lamps light. When the engine pump has been used, it may always be confirmed that the wheels are down and locked by operating the hand pump until increased resistance is felt.

(ii) After lowering the undercarriage, select flaps "Down", at a speed not exceeding 130 A.S.I. reading, and press the oil valve operating lever, or operate the handpump, until the flap indicator shows flaps fully down. As soon as the flaps are depressed there is an appreciable nose down change in trim which can be relieved by adjusting the elevator trimming tabs.

(iii) In the event of an unsuccessful landing the aeroplane should be taken-off again without raising the flaps. It can be climbed with undercarriage and flaps down.

(iv) Before landing check the air pressure in the brake system to ensure availability of the brakes; the pressure should be not less than 120 lb./sq.in. for efficient braking.

(v) If for any reason a landing is being made with the flaps up increase the approach speed by 10 m.p.h., A.S.I. reading.

Undercarriage EMERGENCY operation

14. If difficulty is experienced in selecting wheels "Down", or the wheels fail to drop (indicated additionally by the failure of the red lights to extinguish), select wheels "Up" again and press the operating lever for 15 seconds or operate

the handpump, after which select wheels "Down" immediately. If this action fails to lower the undercarriage, reduce speed to 90 m.p.h., A.S.I. reading and press with both feet on the undercarriage emergency release knobs and at the same time select wheels "Down".

Landing

15. Landing is normal. The brakes are powerful and on smooth ground may be applied without fear of the aeroplane turning on to its nose, even with the C.G. in the forward position.

Shutting down

16. The engine should be allowed to idle for a short period before switching off, the fuel being turned off first and the switches cut only when irregular firing becomes noticeable. Switch off the undercarriage indicator. Set flaps up and make certain that the safety catch of the hydraulic selector is covering the wheels "Up" position.

Diving

17. The maximum diving speed is 380 m.p.h., A.S.I. reading. At less than one-third throttle opening, r.p.m. must not exceed 3,000; at more than one-third throttle opening the engine speed may exceed 3,000 r.p.m. for periods of not more than 20 seconds with a momentary maximum speed of 3,600 r.p.m. The boost pressure is automatically limited to + 6½ lb./sq.in. It is not unusual for the engine to run erratically during a steep dive. When diving the trimming tabs should be set as for level flight; they must not be used to assist recovery from a dive. The radiator flap should be set in the closed or normal position and the cockpit hood may be open or closed.

Forced landing due to engine failure

18. Unless a field of ample size is available the undercarriage should be left up. If there is sufficient time the selector should be set to flaps "Down" and the handpump used to depress the flaps fully.

Side-slipping

19. Side-slipping at a steep angle results in the nose dropping, but gentle side-slips can be used if necessary.

Flying in poor visibility

20. When necessary to fly at low altitude, it is advisable to open the cockpit hood and lower the flaps fully. In this condition a speed of 80 - 90 m.p.h., A.S.I. reading may be maintained with engine r.p.m. of 1,700 - 1,800 without vibration and with good control. In addition, some pilots prefer to lower the undercarriage. In hot weather it may be necessary to lower fully the radiator flap owing to the reduction of air flow through the radiator occasioned by the depressed wing flap.

Stalling and spinning

21. Stalling.- With the flaps and undercarriage up the aeroplane stalls at a speed of 72 m.p.h., A.S.I. reading. With flaps and undercarriage down the stalling speed is 55 m.p.h., A.S.I. reading.

22. Spinning.- Spinning of Hurricanes is prohibited (A.M.O.A.15/1938). The following extract from an Experimental Establishment report is included in order that a recovery may be made from an inadvertent spin.

"The aeroplane is easy to spin, more noticeably so at the extended aft centre of gravity. The first three turns are irregular, but subsequent turns are smooth in general. At the extended aft centre of gravity turns to the right tend to be less smooth, having a slightly variable rate of rotation. The first turn of the spin is quick with the nose well down, but after two more turns the aeroplane assumes a more normal attitude.

Measurements of heights and times show no definite variation, with change in position, of the centre of gravity or with changes in the direction of the spin.

The following table gives the average time and height loss recorded during the spins:-

Height at entry into spin:- 18,000 ft.	(I.C.A.N.) Air Temp.18°C.
Height loss for 3 turn spin	1,200 feet.
Time taken for 3 turn spin	11 seconds.
Height loss for 8 turn spin	3,200 feet.
Time taken for 8 turn spin	23 seconds.

The recovery appears to be unrelated to the number of turns made, i.e. 3 or 8, the rotation being stopped within one or two turns subsequent to the correct sequence of control movements for recovery, the subsequent height loss being about 1,000 feet. A further 1,000 feet is lost in returning to level flight. The average total height lost from initiation of the spin to attainment of level flight is about 3,800 feet for a three turn spin and about 5,800 feet for an eight turn spin.

Recovery in all the above spins was made by applying full opposite rudder and then slowly easing the control column forward towards the central (neutral) position. The height loss in recovery is very sensitive to movement of the control column Forward movement of the control column beyond a position just a of central, or a coarse movement forward of the control column, increases the height lost and it must be emphasised, therefore, that the control column be eased forward slowly to a position just aft of central after full opposite rudder has been applied. In general it has been found preferable to apply full opposite rudder, and then make a slight pause before easing the control column forward.

It appears that the aeroplane emerges from a spin in a stalled state which persists for a considerable portion of the resultant dive if backwards pressure is exerted on the control column. If however the control column is pushed forward in recovery so that no effort is made to flatten out from the dive until a reasonable airspeed is reached, the stalled condition is

avoided but the height lost is prohibitive. It will be seen, therefore, that if recovery is made according to Flying Training Manual Part I., the loss of height during the recovery is normal considering the wing loading. On the other hand there is fear of flicking into a spin in the other direction because the aeroplane emerges from the spin in a stalled state. Coarse backward movement of the elevator, therefore, at even a later stage of the curved path in the dive recovery may result in further deterioration of the lateral control by virtue of the increased loading or acceleration. Quick application of the rudder in the dive recovery phase is required to keep the aeroplane straight, and correct the tendency to 'flick'.

The instructions laid down in the Flying Training Manual Part I., Chapter III, paragraph 134, are applicable to the Hurricane, but should be amplified in the light of the foregoing remarks.

Fuel capacity and consumptions

23. Effective fuel capacity.-

Two main tanks - 33 gallons each	= 66 gallons
One reserve tank	= 28 "
Total effective capacity	94 gallons

Fuel consumptions.- The following table will be found useful in determining endurances:-

Maximum fuel consumptions
(at altitudes stated)

Condition of flight	r.p.m.	Gallons per hour	Total capacity endurance	Endurance per 5 gallons
Climbing	2,600	81 (at 12,000 ft.)	1.16 hrs.	3.7 mins.
All-out level	3,000	89 (at 17,000 ft.)	1.05 "	3.4 "
Max. cruising (automatic rich)	2,600	64 (at 8,000 ft.)	1.47 "	4.7 "
Max. cruising (automatic weak)	2,600	47 (at 12,000ft.)	2.0 "	6.4 "
Most economical cruising	1,900	20 (at 17,000 ft.)	4.7 "	15 "

Oil capacity

24. The oil tank has a total capacity of 10½ gallons and an effective capacity of 7½ gallons.

Notes concerning the Merlin II engine

25. The following should be carefully noted.
Note:- The automatic mixture control lever has two positions only i.e. "Rich" and "Weak"; there are no intermediate positions. The adjustment of the mixture strength to meet the varying conditions of altitude is effected by the automatic unit on the engine. The mixture control lever is returned to the "Rich" position by the closing movement of the throttle control lever.

(i) Limiting operational conditions.-

Take-off (up to 1,000 ft. or for 3 mins.)	Maximum r.p.m. Minimum r.p.m. at maximum boost (+6½ lb./sq.in.)	2,850* 2,650
Climb	Maximum r.p.m. at maximum boost (+6½ lb./sq.in.)	2,600*
Maximum cruising (mixture control "Rich")	Maximum r.p.m. at maximum boost (+4½ lb./sq.in.)	2,600
Economical cruising (mixture control "Weak")	Maximum r.p.m. at maximum boost (+2½ lb./sq.in.)	2,600
All-out level (5 mins. limit)	Maximum r.p.m. at maximum boost (+6½ lb./sq.in.)	3,000
Maximum dive (See para.17)	Momentary maximum r.p.m. at maximum boost (+6½ lb./sq.in.)	3,600

*These r.p.m. will not be obtained with a fixed-pitch airscrew.

(ii) Oil pressures.-

Normal	60 lb./sq.in.
Emergency minimum (5 mins. limit)	45 lb./sq.in.

(iii) Oil inlet temperatures.-

Minimum for opening up	15°C
Maximum for continuous cruising	90°C
Maximum for climbing	90°C
Emergency maximum (5 mins. limit)	95°C

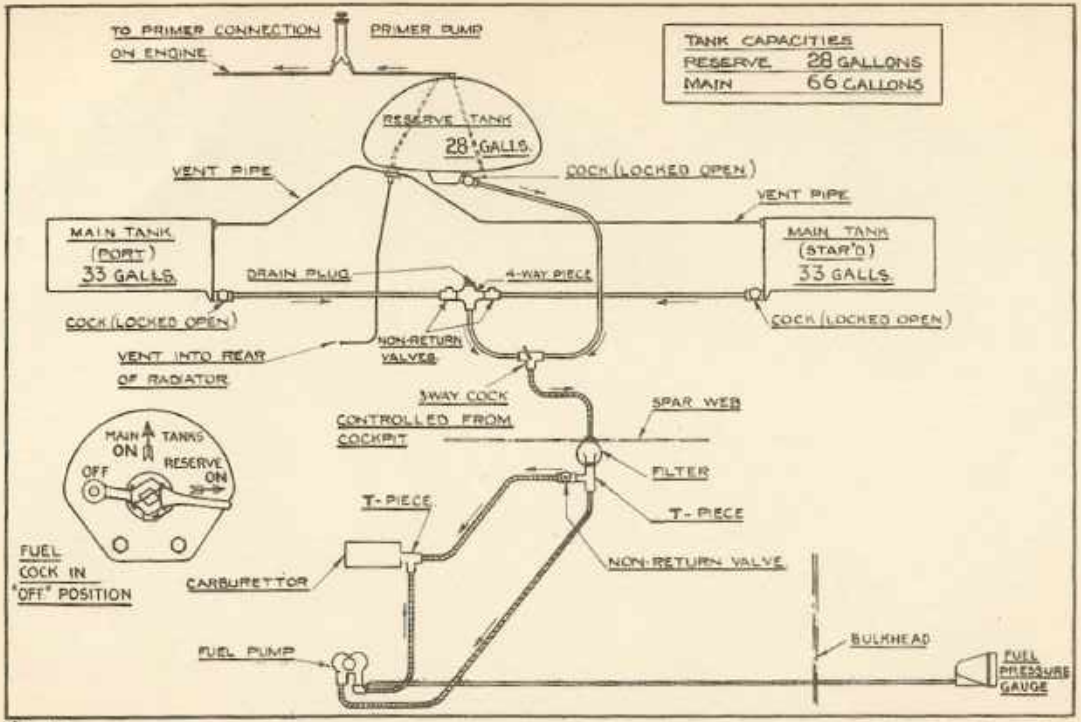
(iv) Coolant temperature.-

The engine which employs ethylene glycol as the cooling medium, should not be opened up to full power until the radiator temperature exceeds 70°C. The maximum permissible temperature in flight is 120°C and the recommended cruising temperature should not exceed 95°C.

Correction of A.S.I. reading for Position Error

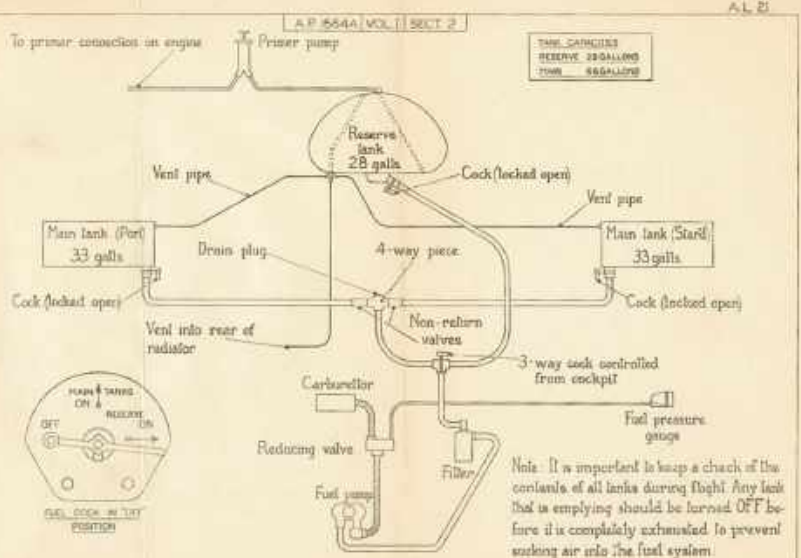
26. Note the following.-

At	80	m.p.h.	A.S.I.	reading	add	6.0	m.p.h.
"	100	"	"	"	"	3.2	"
"	120	"	"	"	"	0.5	"
"	140	"	"	"	subtract	1.7	"
"	160	"	"	"	"	4.0	"
"	180	"	"	"	"	6.0	"
"	200	"	"	"	"	7.5	"
"	220	"	"	"	"	8.7	"
"	240	"	"	"	"	9.5	"
"	260	"	"	"	"	9.7	"



F.S./2a.

FUEL SYSTEM AP 1564A. VOL I SECT. 2 FIG. 1



Note. It is important to keep a check of the contents of all tanks during flight. Any tank that is emptying should be turned OFF before it is completely exhausted, to prevent sucking air into the fuel system.

FIG. 1

FUEL SYSTEM DIAGRAM

FIG. 1

SECTION 3

MAINTENANCE AND HANDLING OPERATIONS

SECTION 3

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SECTION 3

MAINTENANCE
AND HANDLING OPERATIONS

Notes

1. The information given in this Section does not cover all the operations that may be involved during maintenance of the aeroplane; it is intended only to implement the Maintenance Schedule, Vol.II, Pt.2 of this publication.

2. For the maintenance of the following, reference should be made to the relevant Air Publications listed below:-

Engine	A.P.1590B.
Air compressor	A.P.1519.
Instruments	A.P.1275.
Browning guns	A.P.1641C.
Firing control mechanism	A.P.1641E.
Brake system	A.P.1464B.

3. Of the following paragraphs dealing with the removal and assembling of components, the majority refer to the removal of components and, providing additional or contrary instructions for assembling are not given, the procedure for assembling may be assumed to be the same as that for removal but in the reverse order.

RIGGER

GENERAL

Ground equipment

4. The following equipment is required for the efficient handling and maintenance of the aeroplane (ref. A.P.1564A/M.2):-

Universal jacking trestle, No.4, fitted with a 6 in. x 3 in. ash cross beam and suitable blocks at each end, for front end of fuselage.
Universal jacking trestle, type B, fitted with suitable blocks at each end of its beam, for rear end of fuselage.
Handling bar, for rear end of fuselage.
2-ton screw jacks, type B, for bottom of each undercarriage leg.
Side-tracking skates, for undercarriage wheels.
Universal jacking trestles, No.5, for main plane.
Lifting brackets, inner, for outer planes.
Lifting brackets, outer, for outer planes.
Lifting handles, inner, for outer planes.
Lifting handles, outer, for outer planes.
Extractor, for main plane joint pins.
Incidence board, inner, rib B.
Incidence board, outer, rib U.
Dihedral board, front spar.

Key, for turnbutton fasteners and tank filler caps.
Protecting sleeves, rubber, for struts through main fuel tanks.
Stude, for marking main fuel tank covers.
Grease gun, Tecalemit.
Grease gun, Enot.
Air pump, for tyres.
Air pump, for charging pneumatic system.
Air and oil pump, Vickers, for compression legs.
Brake gear valve tools, Dunlop.
Air compressor tools, B.T.H.

Jacking and lifting points

5. At the front end, the fuselage may be lifted on the jacking pads incorporated in the engine mounting whilst the centre section may be jacked beneath the front and rear spar pin joints. The rear end of the fuselage may be trestled beneath the handling bar after it has been fitted through the tube incorporated in the fuselage joints (lower) just forward of the tail wheel; the bar is introduced from either the port or starboard side through corresponding holes in the fairing. An emergency jacking point is also provided at the lower end of each undercarriage compression leg.

6. Should the aeroplane, with engine installed, be raised into the flying position on the undercarriage wheels or on the emergency jacking points at the lower end of each compression leg, it is essential that the rear end of the fuselage is anchored to a ground ring or weight of approximately 2 cwt. as a precaution against the fuselage over-balancing on to its nose. A rope may conveniently be attached around the bottom of the tail wheel leg but, when carrying out rigging operations, care must be taken that the tying down does not put any strain upon the fuselage.

7. For handling the outer planes, the lifting brackets should be screwed into the sockets provided in the undersurface of the plane at the root end and at the tip, the lifting handles then being bolted into their brackets; the handles are of such a length that they project beyond the leading and trailing edges of the outer plane.

Rigging

8. General.- The main plane, the tail plane and the fin are fixed and therefore rigging of the aeroplane is limited to a general check of the angularity of the main plane and the tail plane relative to the fuselage, of the verticality of the fin and the checking of the ranges of movement of the control surfaces. On similar port and starboard diagonal dimensions, a tolerance of 2 in. is allowed, the measurements being taken from the tips of the planes to suitable points at the nose and tail of the aeroplane. The ranges of movement of the control surfaces are given in the Leading Particulars; the tolerances given are not hard and fast but when they are exceeded, the structure as a whole should be examined to determine the cause of the distortion. The rigging of the outer planes may be checked by placing the incidence and dihedral boards in the positions shown in fig.7, having first placed the aeroplane in the rigging position as described in para.9.

9. Rigging position.- The fuselage should be supported on adjustable trestles beneath the jacking points on the engine mounting and rear fuselage (see para.5) until the undercarriage and tail wheels are clear of the ground; the trestles should then be adjusted until the fuselage is level both longitudinally and transversely. Longitudinal level is checked by placing a straightedge and level across the levelling clips on port side struts GH and KF (see fig.7), transverse level being similarly obtained from the levelling clips on side struts GH, port and starboard.

10. Checking aileron, elevator and rudder.- With the aeroplane in the rigging position (see para.9), set the rudder bar at right-angles to the fuselage centre line (see para.16), the upper end of the control column in line with the lower portion and the control column as a whole 7° 30' aft of the vertical. Check that the trailing edges of the main plane and ailerons are in alignment, that the rudder is in line with the centre line of the fuselage (not the fin centre line) and that the elevator is in line with the tail plane.

11. Checking the rear fuselage.- The rear fuselage may be checked for overall alignment and freedom from twist as follows, referring to Sect.6, Chap.1, Fig.2 for the designation of the fuselage joints:-

(i) Place the fuselage in the rigging position as described in para.9.

(ii) Drop plumblines from the centre of joint U and the midpoint of cross strut HH to align on a cord representing the plan centre line of the fuselage, the cord being stretched tightly between two weights (or over two supports) a few inches above and parallel with the ground.

(iii) Drop further plumblines from the midpoints of cross struts PP, OO and JJ and, if the fuselage is true about the plan centre line, these plumblines will align on the ground cord.

(iv) Check the rear fuselage for freedom from twist by means of a spirit level laid across the plug ends at joints R.

(v) Make any necessary adjustments for truing-up the rear fuselage by tensioning the bracing wires in the top and bottom panels, care being taken to ensure that the tension of the wires in adjacent panels is approximately equal.

12. Ailerons.- Secure the trailing edges of the ailerons in line with the trailing edges of the main plane (no droop is intended) and the spade grip in line with the control column; for this latter operation, the lugged bracket of the flying controls locking gear may generally be employed but care should be taken that the gear does maintain the spade grip in its neutral position. Connect the cables to the tie-rods, setting the cables symmetrically about the pulleys in the outer planes and the cable drum in the fuselage; tighten the cable turnbuckles to suit.

13. During flight trials of a new aeroplane it is sometimes found that when the hand is removed from the control column one aileron tends to rise and the other to drop, showing that the ailerons are not in exact balance. This tendency is corrected by the attachment of a suitable length of 5/16 in. manilla cord to the upper side of the trailing edge of the up-going aileron. Normally, correct trim is obtained by this method during the manufacturer's flight trials for each new aeroplane, and unless the ailerons are subsequently damaged they should remain in correct trim whilst in service.

14. Upon fitting a new aileron, it will be necessary to remove any cord already fitted to the other aileron before checking the trim by flying the aeroplane "hands off". If the trial flight reveals the ailerons to be out of balance, the length of cord to be applied to the up-going aileron will have to be determined by trial. When the correct length has been found by further trial flights, the cord should be attached to the upper side of, and mid-way along, the trailing edge of the up-going aileron; the length of cord attached should not exceed 24 in. The cord should be secured by means of a serrated-edge fabric strip, 2½ in. wide, doped to the under-surface, around the edge, and on to the upper surface.

15. Elevator.- Place the aeroplane in the rigging position (see para.9) and secure the elevator in its neutral position, i.e. in line with the tail plane; adjust the lengths of the elevator cables by means of the turnbuckles at their front ends until the control column is set 7° 30' aft of the vertical.

16. Rudder.- Place the rudder in line with the fuselage centre line (not the fin centre line) and secure the rudder bar at right-angles to the fuselage centre line; for this latter purpose, the struts of the flying controls locking gear may conveniently be employed, checking that the struts do retain the rudder bar in the correct position. Adjust the cables to their correct tension by means of the turnbuckles beneath fuselage cross strut JJ (see Sect.6, Chap.1, Fig.2).

17. Rudder balance flap.- The balance flap cables should be fitted in similarly-positioned holes in each arm on either side of the flap, the cable length being adjusted so that the flap is in line with the trailing edge of the rudder when the rudder is in line with the fuselage centre line. When the cables terminate at the inner holes, the flap remains approximately parallel with the centre line of the aeroplane through all angular movements of the rudder; to reduce the degree of balance, move the cables outboard.

18. Tail trimming flaps.- When the cockpit indicator on the handwheel bracket is at zero the trailing edges of the tail trimming flaps should be in line with the trailing edge of the elevator. The chain around the sprocket of the cockpit handwheel should be symmetrically disposed about the sprocket, the ends of the chain being approximately 11 in. from the centre of the sprocket. The chains around each worm gear within each half-elevator, should be disposed about the sprockets so that their ends are approximately 9½ in. from the centre of their respective corner sprockets. In front of the elevator spar, the lengths of cable running forward from the ends of the bowden casings to the nipples connecting with the fuselage control

cables should be approximately 9 in.; also the connector in the balance cable should be positioned not more than ½ in. on either side of the centre line of the aeroplane.

19. The control should be operated to move the flaps to their extreme position, up and down, noting that the cable connectors do not foul the fairleads; should the connectors foul the fairleads the position of the chain on the handwheel sprocket should be slightly altered. It should also be noted that, from the fairlead clipped to fuselage cross strut NN, the top control cable passes to starboard and the bottom cable to port.

FUSELAGE

Airscrew

20. Removal.- Remove the locknut, securing nut and washer at the nose of the spinner; withdraw the spinner. Remove the fixing stud and base plate by removing the six nuts, washers and split-pins securing the base plate to the front flange of the airscrew hub. Unlock the tabwashers and remove the twelve nuts securing the front flange of the airscrew hub; remove the front flange and airscrew.

UNDERCARRIAGE

Compression leg

21. Warning.- It is extremely important to note that the air pressure must be released before attempting any dismantling operations; failure to observe these precautions may result in a serious accident .

22. General.- Each oleo-pneumatic compression leg contains 3.28 pints of type A anti-freezing oil (Stores Ref.34A/43 and 46) with air at the following pressures to suit various loadings of the aeroplane; the table is not to be taken as authorizing weights in excess of those laid down in the Weight Sheet Summary.

Weight of aeroplane (lb.)	5,850	6,000,	6,100	6,200
Pressure (lb.per sq.in.)	362	370	377	385

When checking the air pressure and/or the oil level, the aeroplane should be supported with the appropriate leg clear of the ground.

23. The compression legs are supplied as spares with the correct quantity of oil, but with air at atmospheric pressure; they should be stored in this condition with the air cylinder uppermost. It is advisable however to check the oil level (see para.26) before charging with air to the pressure stated in para.22; it is also advisable to check the oil level of a compression leg which has been installed on a aeroplane and from which oil has escaped through the air valve due to the valve having been opened to permit easy closure of the leg when testing undercarriage movements and clearances.

24. Once the compression legs are charged with oil and air as required, it is advisable not to interfere with them unless there is evidence of air or oil leakage. The following notes will assist in the diagnosis of faults:-

(i) With the oil level correct, the air pressure is too low if less than 3½ in. of the sliding portion of the piston tube is exposed.

(ii) With the oil level correct, the air pressure is too high if more than 4½ in. of the sliding portion of the piston tube is exposed.

(iii) With the air pressure correct, the oil level is too low if the piston travel is excessive and the aeroplane rolls laterally on a turn.

(iv) With the air pressure correct, the oil level is too high if the leg is harsh in action.

(v) Excessive quantities of oil on the piston and attachment fittings usually denote that the gland packings are worn and need replacement. A leakage from this source can be temporarily remedied by tightening the gland nut but new rings should be fitted (see para.32) as soon as is convenient.

25. Checking air pressure.- Trestle the aeroplane (see para.5) until the undercarriage wheels are clear of the ground and connect the pipeline from the Vickers pump to the air valve; charge the line to the pressure required in the compression leg. Open the air valve two turns and read the pressure on the gauge incorporated in the pump. If a cylinder is used for charging purposes, an air pressure gauge should be incorporated in the pipeline from the cylinder to the air valve.

26. Checking oil level.- If the aeroplane has just landed or taxied, the oil will be in an aerated condition and it is therefore advisable to wait for approximately 15 minutes before checking the oil level. Trestle the aeroplane until the undercarriage wheels are clear of the ground; unscrew the air valve slightly and wait until the air pressure inside the compression leg is equal to that of the atmosphere. Recharge the compression leg with air until the internal pressure is approximately 50 lb. per sq.in.; allow the oil to settle for a few minutes and then open the oil level plug three or four turns. If the air escaping through the oil level valve is free of oil, the oil level is too low but if large quantities of oil are ejected with the air, the oil level is too high; if the escaping air only carries a small amount of oil mist, the level may be taken as correct.

27. Lowering oil level.- Trestle the aeroplane until the undercarriage wheels are clear of the ground. Unscrew the oil valve slightly and allow air to pass through the leg from the pump or cylinder until oil no longer escapes with the air; if the air is passed through the leg too rapidly, it may lower the oil level more than required. Shut off the air supply and wait two or three minutes for the oil to settle to a common level both inside and outside the piston tube; repeat the process until the escaping air only carries a small amount of oil mist.

28. Raising oil level.- After trestling the aeroplane until the undercarriage wheels are clear of the ground, pump in an excess of oil and lower the oil level as described in para.27.

29. Lubrication.- When lubricating the gland at the lower end of the cylinder tube, it is important that the gland should only receive sufficient oil for its proper lubrication; if large quantities of oil are forced into the gland, some may find its way into the cylinder tube and increase the oil content of the leg.

30. Checking gland packings.- It may be found that a leg which has been standing in one position for a long period is somewhat sluggish in action due to the oil attacking the composition of the packing rings and causing temporary adhesion to the piston. This should rectify itself after a short period of taxying, but if it persists the gland should be removed and cleaned.

31. Removing piston tube and gland packing.- Unscrew the oil level valve and release the air from the cylinder, at the same time pumping in oil through the air valve; when oil only is expelled, screw down the oil valve and remove the gland capping ring, the scraper ring and the gland nut. Remove the six bolts situated around the cylinder tube midway between the gland and the lugged collar for the radius rod and side stay; this will permit the splined ring within the cylinder to be withdrawn when the piston tube is removed. Continue pumping oil into the cylinder until the gland tubular capping ring and the packing are forced out from the cylinder tube. Unscrew and remove the packing supporting ring; withdraw the piston tube and with it the internal splined ring.

32. Fitting new gland packing rings.- The new rings should be soaked in type A anti-freezing oil for at least twelve hours before they are required for fitting. With the oil and air valves closed, invert the cylinder tube and, after ensuring that the oil has been well drained from the cylinder tube, pour in 3.28 pints of type A anti-freezing oil; insert the piston tube but do not displace the oil. Having removed the stub axle from the piston tube, slip the packing supporting ring over the piston tube and screw it into the cylinder tube. Slip the new packing ring over the piston tube (with its feather edge inwards) and follow it with the tubular capping ring; tap the packing into place, using a wooden drift upon the outer end of the tubular capping ring. Screw the gland nut down on to the ring and slightly increase the pressure to ensure that the packing is in its correct position; release the gland nut about one turn to permit the packing to expand and work automatically. Fit the scraper ring and gland capping ring over the piston tube; tighten the gland capping ring and lock it with wire. When replacing the six securing screws for the internal splined ring, it is essential that the copper washers are annealed immediately before use.

Wheels

33. Removal.- Note the position of the stirrup in order that it may be refitted exactly in its original position; in most cases there is only one possible position of the stirrup that will allow the bolt to register with both the slotted nut of the axle and the shank of the stirrup. Jack the aeroplane until the

undercarriage wheels are clear of the ground, remove the split-pin through the stirrup locking nut and remove the stirrup. Remove the nut and bolt securing the wheel retaining nut; unscrew the wheel retaining nut and withdraw the wheel from the axle. After refitting the wheel and stirrup, the position of the stirrup should be checked by retracting the undercarriage.

34. Repacking bearings with lubricant.- The lubricant should be smeared over the central portion of the wheel axle before the wheel is refitted; care must be taken not to apply more lubricant than is necessary, as any excess will be thrown outwards on to the brakes by the rotation of the wheels.

Micro-switches

35. Testing.- The plungers of the micro-switches, which are in circuit with the warning devices, should operate under a load of 1 lb. ± 4 oz.

Single undercarriage units

36. Retraction.- By disconnecting the latch operating cable of one unit, it is possible to retract the other unit separately, but this practice is not desirable as damage to the gear may result if the latch should slip. When it is required to retract a single undercarriage unit, the other unit should be held down by external means, e.g., a weight or a picket.

TAIL WHEEL UNIT

Compression leg

37. General.- All parts of the compression leg are self-adjusting for wear except the friction band, which may need adjustment (see para.38) to prevent undue oscillation of the wheel when taxying. The free play, up and down, in the compression leg should not exceed $\frac{1}{4}$ in. If excessive movement is present, remove the bolt securing the top attachment fitting; remove the fitting and the spigot cap. Place the requisite number of steel washers on top of the main spring and reassemble the leg. When checking the wear between the inner and outer tubes, it should not be possible to insert a 0.030 in. feeler for any appreciable distance.

38. Adjusting friction band.- The damping of the castoring action provided by the friction band may be varied by altering the tightness of the band by means of the clip bolt. If the distance tube is removed, care should be taken that it is replaced, as undue tightness of the band will interfere with the correct functioning of the self-centring device.

HYDRAULIC SYSTEM

General

39. Absolute cleanliness is essential for the satisfactory operation of the hydraulic system; a diagram of the system is given in fig.13. It is essential that the fluid is maintained

at the correct level in the handpump, otherwise air is likely to be pumped into the system; the handpump reservoir should be full when the aeroplane is in flying position. When replenishing, the filter must remain in the filler neck and only clean fluid should be used; care should be taken that the fluid is not spilled as it may remove the protective coating from parts with which it comes in contact. When it is necessary to drain any part of the system and retain the fluid for further use, the receptacle used must be scrupulously clean as ordinary oil or grease may injure the gland and jointing compositions employed in the system. When pipelines are disconnected, the ends of the pipes must be protected against the entry of dirt and drain plugs or other components must be thoroughly examined before reassembly to ensure freedom from foreign matter.

Filling

40. Trestle the aeroplane in the flying position with the undercarriage wheels just clear of the ground and proceed as follows:-

(i) With the handle of the selector gear set at neutral, pour type A anti-freezing oil (Stores Ref.34A/43 and 46) into the handpump reservoir and operate the handpump until the level ceases to fall; refill the reservoir and again operate the handpump.

(ii) Continue to operate the handpump and fill the reservoir alternately until the fluid level is no longer lowered by the operation of the handpump.

(iii) Disconnect the return pipe at the engine-driven pump, allow it to fill, reconnect the pipe to the pump and refill the reservoir.

(iv) By a similar procedure, fill the larger pipe connecting the control valve to the filter, using the handpump if necessary.

(v) Set the handle of the selector gear to WHEELS UP and, at the piston rod end of one of the undercarriage jacks, unscrew the pipe union a few turns to cause a vent.

(vi) Operate the handpump until fluid runs freely from the vent, retighten the pipe union and refill the reservoir.

(vii) At the other undercarriage jack, repeat the process set out in (v) and (vi) above and again fill the reservoir.

(viii) Operate the handpump to bring the undercarriage into the retracted position and, if necessary, refill the reservoir.

(ix) Set the handle of the selector gear to WHEELS DOWN and, at the anchored end of one of the undercarriage jacks, unscrew the pipe union a few turns to cause a vent.

(x) Operate the handpump until fluid runs freely from the vent, retighten the pipe union and refill the reservoir.

(xi) At the other undercarriage jack, repeat the process set out in (ix) and (x) above and again fill the reservoir.

(xii) Operate the handpump to bring the undercarriage into the alighting position and, if necessary, refill the reservoir.

The jacks and pipelines of the undercarriage system should now be full of fluid.

41. Fill the flap system in a similar manner to that described for the undercarriage in para.40.

42. After filling the flap system, any air remaining in the hydraulic system should then be expelled as follows:-

(i) Lower the aeroplane on to its wheels and start the engine.

(ii) With the handle of the selector gear set at neutral and with the control lever depressed, allow fluid to flow from the engine-driven pump through the control valve and control box to the reservoir; the engine should be run sufficiently fast to enable the engine-driven pump to expel any air that remains in the system.

(iii) With the engine still running, release the control lever and allow fluid to circulate in the engine-driven pump by-pass system for a minute or two.

Handpump

43. The filter in the filler neck requires cleaning after each filling of the hydraulic system. Should leakage occur at the point of emergence of the shaft carrying the handle, remove the wire which locks the gland nut, tighten the nut and relock with wire; care must be taken not to over-tighten the nut which might cause binding of the shaft. The test pressure for the hand-pump is 800 lb. per sq.in.

Filter

44. Cleaning.- Unscrew the cap at the bottom of the filter, remove the filter element and wash it in petrol; the element should be dried by means of an air-blast before replacement. When replacing, care should be taken that the washer above the element is assembled with its lipped rim downwards and that no foreign matter remains inside.

Control valve

45. If there is any sign of leakage at the connections, new copper-asbestos washers should be fitted; if the inlet connection is removed, no particular care is required in its replacement but if either the outlet connection to the filter and reservoir, or the outlet connection to the control box is removed, care must be taken to ensure that the springs and centralizing caps are correctly fitted on reassembly. No adjustment may be made to the screw which controls the spring-loading of the relief

valve. The blow-off pressure is 800 lb. per sq.in. and the test pressure 1,200 lb. per sq.in.

Control box

46. Normally, no attempt should be made to alter the setting of the relief valves which control the release pressures but, in a case of emergency only, adjustment may be made by loosening the locknut and screwing or unscrewing the adjusting pin. Should there be any evidence of leakage, the tightness of the connections should be tested but, if this appears to be correct, new copper-asbestos washers should be fitted. The test pressure for the return connection is 250 lb. per sq.in. and that for the other connections is 1,750 lb. per sq.in.; the blow-off pressure for WHEELS UP is 1,400 ± 50 lb. per sq.in. and for WHEELS DOWN is 850 ± 50 lb. per sq.in.; the blow-off pressure for FLAPS UP is 850 ± 30 lb. per sq.in. and for FLAPS DOWN is 370 ± 15 lb. per sq.in.

Jacks

47. The test pressure is 1,200 lb. per sq.in. except for the $\frac{1}{4}$ in. B.S.P. union on the flap jack where it is 700 lb. per sq.in.

48. Adjusting for length.- Length adjustment of the jacks may be effected by altering the position of the eye which is screwed into the outer end of the piston rod. Release the locknut and its securing tabwasher; remove the eye. Fit a new tabwasher, screw the eye into the desired position, tighten the locknut and lock it with its tabwasher.

49. Checking positions of undercarriage jacks.- The length and the position of each jack relative to the undercarriage may be checked by removing the bolt connecting the jack to the triangulated lever. When fully extended, the length of the piston rod must be such that, with the undercarriage locked down, the eye of the jack can be placed outboard of the fork on the triangulated lever and not more than $\frac{3}{32}$ in. from it.

PNEUMATIC SYSTEM

Charging

50. With the aeroplane on the ground, if the pressure in the system is less than 150 lb. per sq.in. (as shown on the "supply" scale of the pressure gauge in the cockpit) it should be increased to not more than 300 lb. per sq.in. by means of a handpump or compressed air cylinder. Access to the charging connection, mounted on the port side of the fireproof bulkhead, is obtained by removing the port intermediate side panel of the engine cowling.

Oil trap

51. Draining.- Slacken off the locknut and unscrew the drain plug in the bottom of the trap; after two or three turns,

the oil should flow through the small hole in the side of the drain connection and may be caught in a suitable receptacle. If necessary, the drain plug may be removed completely.

52. Cleaning.- Detach the inlet and outlet pipes by unscrewing each union nut and, with a C-spanner, unscrew the top half of the trap. Slacken the bolt closing the supporting bracket and withdraw the trap downwards; lift out the cap embodying the top pipe connection. Clean the trap with a dry rag, taking care that the drain and the pipe in the cap are free from foreign matter.

Oil reservoir

53. Replenishing.- Slacken off the locknut and unscrew the plug in the overflow connection. Remove the filler cap and insert a filter funnel in the filler neck; pour in treated castor oil to Specification D.T.D.72 (Stores Ref.34A/5 and 45) until the oil commences to flow through the small hole in the underside of the overflow connection. Tighten the overflow plug and the locknut; replace the filler cap.

54. Draining.- Slacken off the locknut and unscrew the plug in the overflow connection two or three turns, detach the air pipe from the bottom connection and allow the oil to drain away through a funnel and tube into a suitable receptacle.

Air cylinder

55. Draining.- Detach the air pipe at each end of the cylinder by unscrewing the union nuts; release the cylinder by removing the bolts from the securing straps. Swing the straps clear and withdraw the cylinder downwards and to starboard; unscrew the union from one end of the cylinder and drain any condensed moisture.

Air filter

56. Draining.- Slacken off the locknut and unscrew the drain plug in the bottom of the filter; after two or three turns the oil should flow through the small hole in the side of the drain connection and may be caught in a suitable receptacle. If necessary, the drain plug may be removed completely.

57. Cleaning.- Detach the inlet and outlet pipes by unscrewing each union nut and, with a C-spanner, unscrew the top half of the filter. Slacken the bolt closing the supporting bracket and withdraw the filter downwards; lift out the cap embodying the top pipe connection and remove the felt filter element. Wash the felt element in petrol and dry it by means of an air-blast. Clean the internal surfaces of the filter with a dry rag, taking care that the drain connection and the pipe in the cap are free from foreign matter; replace the filter element. Assemble the remainder of the filter and replace it in its mounting bracket.

Pressure reduction valve

58. Adjusting.- To adjust the delivery pressure, remove the split-pin securing the screwed plug within the end of the

valve casing and screw the plug in to decrease the pressure or out to increase the pressure; replace the split pin.

PITTER

FUSELAGE

Hand-starting gear

59. Removal of handles from stowage.- The starting handles are stowed in the wheel recess beneath the centre section, one on each side wall. To remove a handle, unscrew the wing nut on the securing bracket and swing the bolt downwards; then lift the clip, disengage the starting handle and withdraw it forwards.

60. Adjustment of chain from handle shaft sprocket.- Slacken the nuts attaching the bearing brackets of the handle shaft to engine mounting struts XZ, port and starboard (see Sect.6, Chap.1, Fig.2), and slide the bearing brackets forward to tighten the chain or rearward to loosen it.

61. Adjustment of chain driving magneto sprocket.- Remove packing washers from under the magneto feet to tighten the chain or add washers to loosen it.

62. Adjustment of chain driving engine sprocket.- Slacken the nuts attaching the bearing bracket to engine mounting strut XY, starboard (see Sect.6, Chap.1, Fig.2) and slide the bearing with its double sprocket forward to tighten the chain or rearward to loosen it; this adjustment will necessitate adjustment of the other two chains as described in pares.60 and 61. When tightening the bearing brackets on the struts after adjustment of the chains, care should be taken that the sprockets are parallel with one another in order to avoid twist in the chains.

Airscrew

63. Removal.- Reference should be made to para.20 for the removal of this component.

Engine controls

64. Adjusting for length.- The lengths of both the throttle and mixture controls may be altered by screwing the fork-ends along the sliding rods at each end of each control in the desired direction; the fork-ends are locked with nuts.

65. Adjusting control stops.- The stops are situated at the forward ends of the throttle and mixture lever slots in the quadrant plate. Slacken off the two screws in each stop and slide the stop forward or rearward as required to increase or decrease respectively the maximum degree of throttle opening or weakness of mixture.

66. moval of inner linkage.- At the engine end, uncouple the control at the ball joint and unscrew the sliding rod. Disconnect the throttle control at the cockpit end by removing the split-pin, nut, washer and roller from the bolt securing the fork-end to the throttle lever; disconnect the mixture control at its rear end by removing the split-pin and tabwasher from the headed pin coupling the fork-end to the mixture lever. After removing the bolt from the throttle lever and the headed pin from the mixture lever, withdraw each inner linkage with its olives and tubelets from the respective casing tube by pulling on the rear sliding rod.

67. Inspection of inner cable.- The cable may be inspected by removing the locking barrel from the screwed terminal rod, sliding the inspection tubelet back and then, in turn, moving each olive and tubelet along the cable until it has been examined throughout its length.

68. Adjustment of inner linkage.- A linkage is satisfactorily adjusted when there is no end play between the olives and the tubelets; increasing the tension beyond this point makes the control heavy in operation. The adjustment is made by screwing up the locking barrel to the appropriate point on the screwed terminal rod and then screwing the sliding rod along the terminal rod until it is hard against the locking barrel.

69. Assembling of inner linkage.- Insert the linkage into the casing tube. If the fork-end has been removed from the rear end of the linkage, care must be taken that the fixed end is at the front and the adjustable end at the rear; the fixed end of each sliding rod and casing tube is marked with an F, whilst the adjustable ends are marked with an A. Screw the non-adjustable sliding rod on to the front terminal rod, open the inspection hole by moving the spring clip and check that the sliding rod has been screwed right home. Close the inspection hole and connect the control at each end to the adjacent parts of the control system.

Radiator fairing

70. Removal.- Disconnect the two bracing struts at the rear end of the radiator fairing and the control rods to the radiator flap at the port and starboard sides of the flap. Remove the cover plates in the rear wall of the wheel housing; reach through the holes thus disclosed and disconnect the link on the centre stiffener of the radiator fairing from the fork bolt on the lower boom of the centre section rear spar. Support the fairing, remove all the attachment bolts and screws around its upper flange and lower the fairing away from the fuselage.

71. Assembly.- The assembly procedure is the reverse of that for removal with the addition of the following adjustments. The length of the rear bracing struts may be adjusted by slackening the locknuts and screwing the fork-ends in or out as required, the length of the flap control rods being adjusted in a similar manner.

FUEL SYSTEM

Refuelling

72. The points of access to the fuel filler necks are shown in fig.1. Insert the bonding plug on the filling hose in

the bonding socket adjacent to the filler cap and remove the cap; after filling, disconnect the bonding plug and socket, screw on the cap and replace the access door.

Filter

73. Cleaning.- Turn the fuel distributing cock to the OFF position. Hold up the locking spring and unscrew the wing nut securing the stirrup; swing the stirrup clear of the bottom casing and withdraw the latter together with the strainer unit and spring. Wash the strainer unit in petrol and reassemble the filter; do not use rag for cleaning the strainer unit.

Reserve tank

74. Draining.- Remove the split-pin which locks the sleeve of the drain valve situated at the bottom of the sump. Fit a suitable piece of hose to the nozzle of the drain valve, unscrew the sleeve a few turns and drain the fuel through the hose into a convenient receptacle. When the fuel has ceased to flow, retighten the sleeve and lock it with a split-pin.

75. Removal of sump.- Set the control handle of the fuel distributing cock to the OFF position. Cut the wire locking the isolating cock of the reserve tank sump in the ON position, turn the cock to the OFF position and disconnect the fuel pipe from the cock, moving the freed end out of the way. Place a funnel, to which is attached a length of hose, under the cock, turn the cock to the ON position and drain the fuel into a suitable receptacle. Remove the twelve small bolts securing the sump to the tank shell and thus remove the sump.

Main tanks

76. Draining.- Set the handle of the fuel distributing cock to the OFF position. Remove the door situated at the inboard edge of the tank bottom covering and then the wire locking the isolating cock in the tank sump in the ON position; turn the cock to the OFF position. Uncouple the fuel delivery cock at the tank and loosen the coupling at the other end of the pipe; this coupling will be found on the rear wall of the wheel housing on the centre line of the aeroplane. Fit a suitable length of hose to the isolating cock, open the cock and drain the fuel into a suitable receptacle.

77. Removal of handhole covers.- After draining the fuel tank as described in para.76, the handhole covers may easily be removed from the outboard sides and bottom surfaces of the tank by unscrewing the twelve securing bolts.

OIL SYSTEM

Draining

78. The oil system should be drained when the oil is hot to ensure adequate draining and in order that the viscosity valve shall not close the oil cooler circuit; the system is

drained by separately draining the oil tank and the oil cooler as described in paras.80 and 83 respectively.

Filter

79. Cleaning.- Remove the locking wire and release the adjusting screw at the top of the filter. Unscrew the top cap and remove the inner sealing cap, the spring and the gauze filter. Clean the filter in petrol and dry by means of an air-blast; do not use rag for cleaning the gauze. When reassembling, the filter should be filled with oil before replacing the top cap and great care must be taken that an airtight joint is obtained.

Oil tank

80. Draining.- Remove the under-fairing strip at the bottom rear edge of the oil tank and then the wire locking the drain plug situated at the bottom rear corner of the tank about midway along its length. Unscrew the valve of the drain plug a few turns and drain the oil through a funnel into a suitable receptacle.

81. Removal.- Remove the front and intermediate side cowling panels, the leading edge fillet on the port side and the gap fairing between the centre section and port outer plane. Remove the upper cover over the port main fuel tank and the port side fairing strip under the centre section front spar. After draining the oil tank as described in para.80, disconnect the vent pipe at its connection in the top of the rear wall of the tank by removing the jubilee clips and sliding the rubber hose along the vent pipe. Disconnect the inlet and outlet pipes in the inboard end wall of the tank and the bonding wire from the socket fitting at the filler cap seating by removing the attaching screw. Support the tank and remove the four bolts attaching the tank feet to the brackets on the centre section front spar; remove the tank, replacing the bolts and rubber pads to prevent their loss.

82. Assembly.- The assembly procedure is the reverse of that for removal but in addition the following points should be noted. The rubber pads should be arranged so that one is placed between the tank foot and the bracket, and the other between the tank foot and the washer under the bolt head; it is important that the tank feet attachment bolts are locked with wire.

Oil cooler

83. Draining.- Remove the door in the bottom surface of the radiator fairing and then the wire locking the drain plugs situated in the bottom surface of the radiator; the front plug is the oil cooler drain plug. Remove the drain plug and drain the oil cooler with the aid of a funnel and a hose leading to a suitable receptacle; when the oil has ceased to flow, replace the drain plug and wire it to the coolant radiator drain plug. If the oil does not flow freely, uncouple either the oil inlet or outlet connection at the top of the cooler; access to these connections may be obtained through the door in the top of the radiator fairing above the flap.

84. Removal.- Remove the radiator fairing as described in para.70 and, if necessary, drain the oil cooler as described in para.83. Disconnect the two pipes between the oil cooler and the viscosity valve. Remove the bolts attaching the oil cooler to the radiator shell; six bolts are situated at the top of the cooler whilst two smaller bolts are situated at each end. Lift the oil cooler vertically until the drain plug extension in its lower surface clears the hole in the connecting portion between the two halves of the coolant radiator; remove the cooler.

Viscosity valve

85. Cleaning filter.- Unscrew the large screwed plug at that end of the valve which is adjacent to the pipe leading to the oil cooler; the nut which locks the centre screwed plug to this large screwed plug must not be unscrewed or removed under any circumstances as it is sweated in position after the valve has been calibrated. Remove the large screwed plug taking great care not to damage the bellows during removal; without removing the filter from the valve head, clean the gauze in petrol and dry it by means of an air-blast. The screwed plug, at that end of the valve which is adjacent to the pipe leading to the oil tank, may be removed for inspection of the valve at that end if necessary.

COOLING SYSTEM

Draining

86. Remove the door in the under-surface of the radiator fairing and then the wire locking the drain plugs situated in the bottom surface of the radiator; the rear plug is the coolant radiator drain plug. Remove the drain plug and drain the coolant radiator with the aid of a funnel and a hose leading to a suitable receptacle; when the coolant has ceased to flow, replace the drain plug and wire it to the oil cooler drain plug.

Filling

87. With the tail wheel of the aeroplane on the ground, remove or open the following vents:-

(i) Radiator drain plug.
(ii) Plug on top of the return pipe from the radiator to the engine, about 12 in. aft of the centre section front spar.
(iii) Four vent plugs in the engine outlet pipes, two front and two rear.
(iv) Drain cock on base of engine-driven pump.
(v) Drain tap on each side of carburettor.

88. Remove the filler cap from the header tank and pour in slowly, through a fine-mesh strainer, sufficient coolant to obtain a flow from the radiator drain hole; screw in the drain plug and lock it with wire to the oil cooler drain plug.

89. Continue to pour in coolant as above and, as the coolant content of the system is increased, the coolant will flow in turn from each of the above-mentioned vents, each vent being closed and locked as soon as coolant flows from it; coolant flowing from the vents should be caught in suitable receptacles so that the total quantity remaining in the system may be checked. When the coolant is level with the rim of the filler neck of the header tank, replace the filler cap and run the engine as for warming-up; this will disperse any trapped air. Stop the engine and check the level of the coolant; top up if the level has dropped. Run the engine again until the coolant temperature reaches 60°C, when the engine should be stopped and the header tank topped up if necessary; the system should require 15 gallons of coolant.

Header tank

90. Removal.- Drain the cooling system as described in para.86. Slacken the clip attaching the vent pipe hose connection to the top of the tank and ease off the vent pipe; disconnect the bonding strips at each pipe connection to the header tank. Slacken the clips attaching the three hose connections, one under the tank and two in the front face; loosen the hose on the tank branches. From the connection in the front face of the tank, remove the thermometer bottle and stow it in a position where it is unlikely to be damaged, taking care to avoid sharp bends in the capillary tubing. Disconnect the bonding wire at the rear web of the port rear foot and remove the bolts attaching the four tank feet to their mounting brackets; remove the tank, easing off the loosened hose connections.

91. Assembly.- The installation procedure is the reverse of that for removal described in para.90, but in addition the following points should be noted. When mounting the tank, place a rubber packing over each bolt hole in the mounting brackets, thread the washer and another rubber packing on to each bolt and insert the bolts from below; there should thus be a rubber packing between the tank foot and the bracket, and between the bracket and the washer under the bolt head.

Radiator

92. Removal.- Drain the oil cooler as described in para.83 and remove it as described in para.84; drain the cooling system as described in para.86. Slacken the clips securing the two hose connections at the top of the radiator and loosen the hose on the radiator branches; disconnect the bonding wire at the front starboard edge of the radiator. Support the radiator, remove the four attachment bolts and thus remove the radiator downwards.

INSTRUMENT MAKER

Pressure head

93. Setting.- The setting of the pressure head is given in the Leading Particulars.

WIRELESS OPERATOR MECHANIC

Undercarriage indicator

94. Testing circuits.- Switch on the indicator circuit at the cut-out switch when the green lamps should light for both the port and starboard undercarriage units. Operate the change-over switch and note that the green lamps light in the alternative circuit for each undercarriage unit.

Undercarriage warning buzzer

95. Testing.- With the engine throttle lever in the "closed" position, raise by hand the latch locking one of the undercarriage side stays until the lever operating the micro-switch is just engaged; the warning buzzer should then sound. Repeat the operation raising the other latch. Then move the engine throttle lever forward to slightly more than one-third of its travel and raise each latch as before; this time the buzzer should not sound. Throughout these operations it should be noted that when a latch is lifted the corresponding green lamp on the indicator should not be alight.

96. Cleaning contacts.- Unscrew the five screws round the outside of the instrument and gently pull the buzzer from its case. Disconnect the wires from the terminals outside the case and remove the gauze cover by taking out the two countersunk screws on the top. Unscrew the six countersunk screws from the back of the unit and remove the diaphragm assembly. Clean the contacts by passing a slip of fine emery cloth between them or, if very dirty, remove the adjusting screws and clean both contacts with a magneto file.

97. Adjusting contacts.- Apply the working voltage to the lead-out wires and adjust the contact screw to produce the correct note; relock the contact adjusting screw with the locknut provided. Replace the gauze cover and re-check the buzzer for the correct note before replacing the unit in its case.

Fuel tank gauges

98. Removal.- Disconnect the electrical leads at the gauge and remove the twelve bolts round the securing flange. The gauge may then be lifted from the tank, great care being taken not to bend the float arm.

Bonding

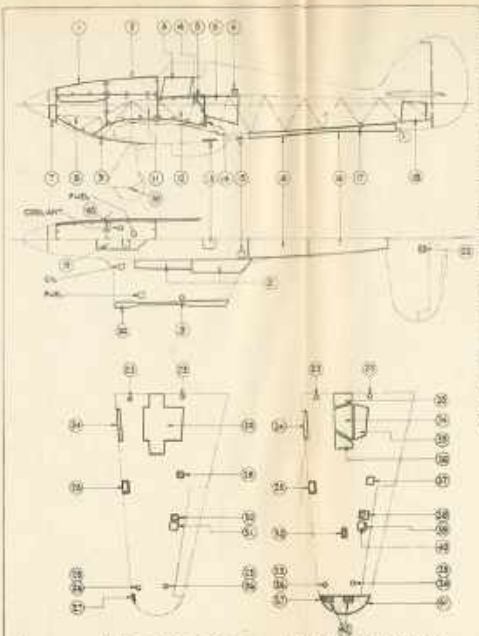
99. Inspection.- To facilitate examination of the bonding system, a diagram of the bonding points is given in fig.12.

Guns

100. Alignment.- Remove the split-pin and release the slotted nut at the bottom of the front mounting bracket; at the rear mounting bracket, release the two locknuts adjacent to the knurled knob at the side of the bracket. To adjust the elevation of a gun, rotate the knurled knob at the bottom of the rear mounting fork until the gun has the required elevation; to adjust the gun laterally, rotate the knurled knob at the side of the mounting bracket. It will usually be possible to rotate the knurled knobs with the fingers, but should they prove too stiff, a 5/32 in. diameter tommy-bar may be inserted in holes provided round their rims. After adjustment, the setting should be locked by tightening the locknuts at the side of the rear mounting bracket; the inner nut should first be tightened with a $\frac{3}{4}$ in. spanner, but not excessively, and then locked with the outer nut. Finally, the slotted nut at the bottom of the front mounting bracket must be tightened and the split-pin replaced.

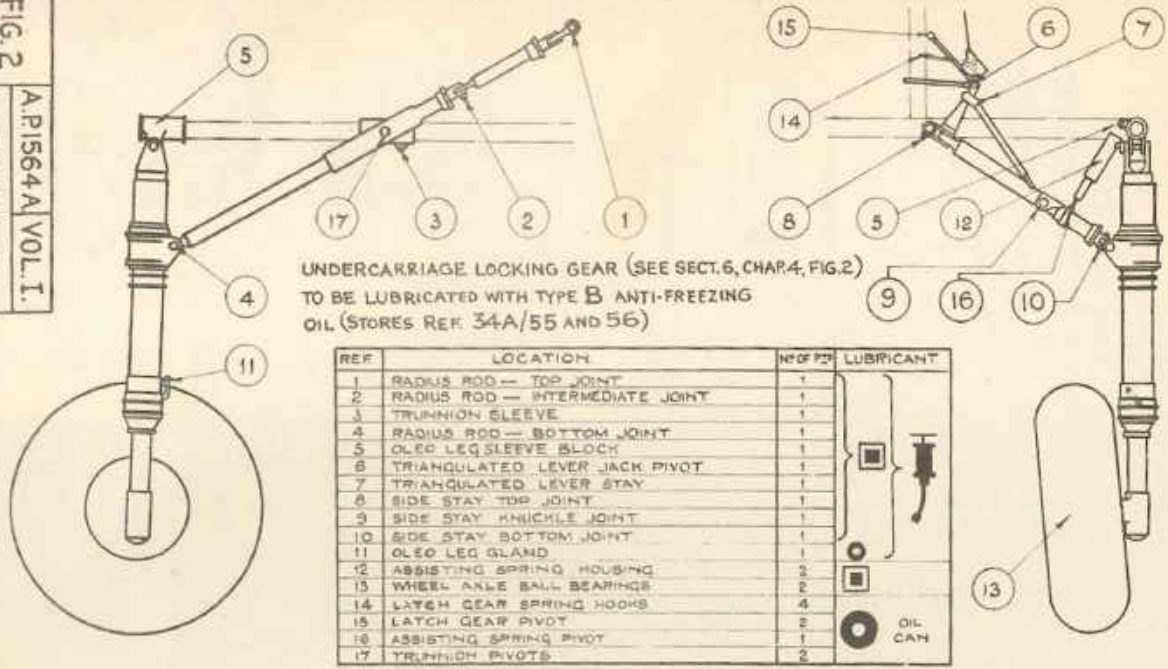
Parachute flares

101. Loading.- Before the flare can be placed in the launching tube, the suspension lug and safety pin must be removed from the central part of the flare casing; the lug is $11\frac{1}{2}$ in. from the bottom of the case and the safety pin is adjacent to the lug. Push forward the projecting pin at the side of the door in the front under-fairing of the rear fuselage, when the door should fall open. With the large end uppermost, pass the flare into the chute with the looped end of the static cord lying on top of the flare; close and secure the door. Remove an appropriate access door in the side of the fuselage and draw the looped end of the static cord through the top ring of the chute; attach it to the forked bolt on joint G by the toggle pin provided. Stow any surplus cord in the canvas pocket on the flare and replace the access door.



	TOP ENGINE PANEL
1	TANK COVER
2	EMERGENCY EXIT PANEL
3	HINGED DOORS (PORT SIDE)
3	ACCESS DOOR IN SIDE FAIRING (STARBOARD)
3	ACCESS DOOR IN SIDE FAIRING (PORT)
4	REMOVABLE PORTION OF NOSE FAIRING
4	FRONT SIDE PANEL (PORT AND STARBOARD)
5	TOWING POINT
6	EMERGENCY TOWING POINT (UNDER SEAT)
11	INTERMEDIATE SIDE PANEL (PORT AND STARBOARD)
12	REAR SIDE PANEL (PORT)
13	RADIATOR FAIRING PANEL
14	REAR SIDE PANEL (STARBOARD)
15	DOOR FOR TRAINING FLAPS (PORT AND STARBOARD)
16	ACCESS DOOR IN UNDERFAIRING
17	HANDLING TUBE
18	ACCESS DOOR IN TAIL BAY FAIRING (PORT)
19	INTERMEDIATE UNDER PANEL
20	CAP FAIRING
21	WALKWAYS
22	HOOKS FOR RIP - ELEVATOR FLAP CABLES
23	OUTER PLANE HANDLING POINT
24	BLAST TUBE DOOR
25	LANDING LAMP WINDOW
26	POINTING AND HANDLING POINT
27	NAVIGATION LAMP WINDOW
28	ACCESS DOORS TO GUNS AND AMMUNITIES
29	HOOD (FRAME) - WING LAMP CONTROL PULLEY
30	HOOD FRAME - ACCESS TO CONTROL RODS
31	ACCESS DOOR TO AILERON CONTROL GEAR
32	INSPECTION DOOR (BOTTOM SKIN)
33	ACCESS DOOR FOR SLOT (PORT)
34	" " " (CENTRE)
35	" " " (RIGHT)
36	" " " (STARB'D)
37	ACCESS DOOR TO LANDING LAMP PULLEY (BOTTOM SKIN)
38	ACCESS DOOR TO AILERON CABLES (BOTTOM SKIN)
39	ACCESS DOOR TO AILERON CONTROL LINKS (BOTTOM SKIN)
40	ACCESS DOOR TO AILERON CONTROL HORN (TOP SKIN)
41	OUTER PLANE REMOVABLE TIP
42	HAND HOLES FOR TIP REMOVAL
43	ACCESS DOOR TO ELECTRIC STARTER PLUG
44	

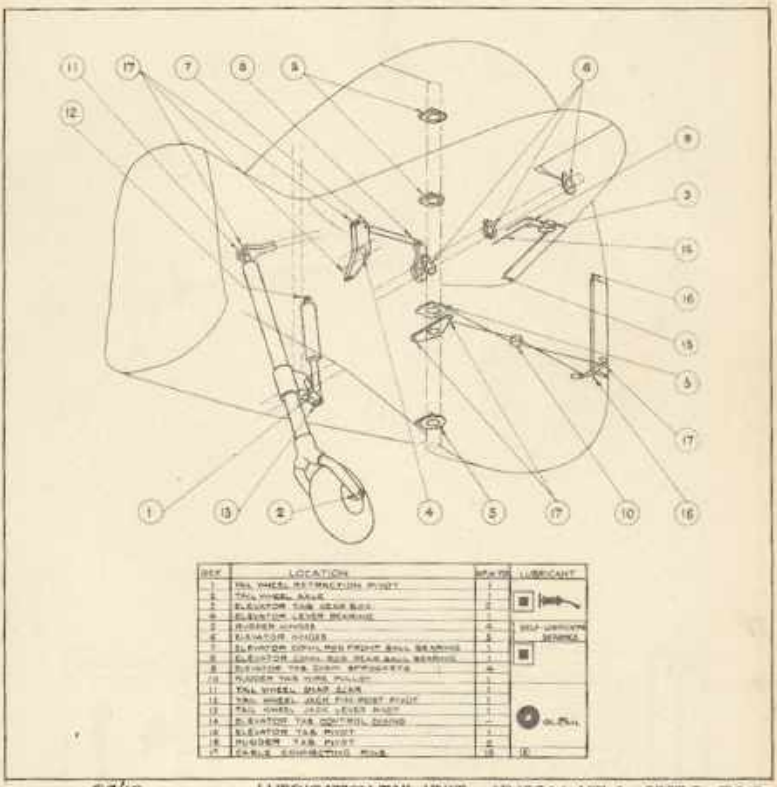
ACCESS DOORS, ETC.



UNDERCARRIAGE LOCKING GEAR (SEE SECT. 6, CHAP. 4, FIG. 2)
TO BE LUBRICATED WITH TYPE B ANTI-FREEZING
OIL (STORES REF. 34A/55 AND 56)

REF	LOCATION	No OF PTS	LUBRICANT
1	RADIUS ROD — TOP JOINT	1	
2	RADIUS ROD — INTERMEDIATE JOINT	1	
3	TRUNNION SLEEVE	1	
4	RADIUS ROD — BOTTOM JOINT	1	
5	OLEO LEG SLEEVE BLOCK	1	
6	TRIANGULATED LEVER JACK PIVOT	1	
7	TRIANGULATED LEVER STAY	1	
8	SIDE STAY TOP JOINT	1	
9	SIDE STAY KNUCKLE JOINT	1	
10	SIDE STAY BOTTOM JOINT	1	
11	OLEO LEG GLAND	1	
12	ASSISTING SPRING HOUSING	2	
13	WHEEL AXLE BALL BEARINGS	2	
14	LATCH GEAR SPRING HOOKS	4	
15	LATCH GEAR PIVOT	2	OIL CAN
16	ASSISTING SPRING PIVOT	1	
17	TRUNNION PIVOTS	2	

LUBRICATION—UNDERCARRIAGE



KEY	LOCATION	NO. PTS	LUBRICANT
1	TAIL WHEEL RETRACTION PIVOT	1	
2	TAIL WHEEL AXLE	1	
3	ELEVATOR TAB GEAR BOX	2	
4	ELEVATOR LEVER BEARING	1	
5	RUDDER HINGES	2	
6	ELEVATOR HINGES	3	
7	ELEVATOR CONTROL ROD FRONT BALL BEARINGS	1	
8	ELEVATOR CONTROL ROD REAR BALL BEARINGS	1	
9	ELEVATOR TAB SHAFT BEARINGS	4	
10	RUDDER TAB TURN PULLEY	1	
11	TAIL WHEEL DRAG LINK	1	
12	TAIL WHEEL JACK PIN POST PIVOT	1	
13	TAIL WHEEL JACK LEVER PIVOT	1	
14	ELEVATOR TAB CONTROL QUADRANT	1	
15	ELEVATOR TAB PIVOT	1	
16	RUDDER TAB PIVOT	2	
17	CABLE CONNECTING PINS	12	

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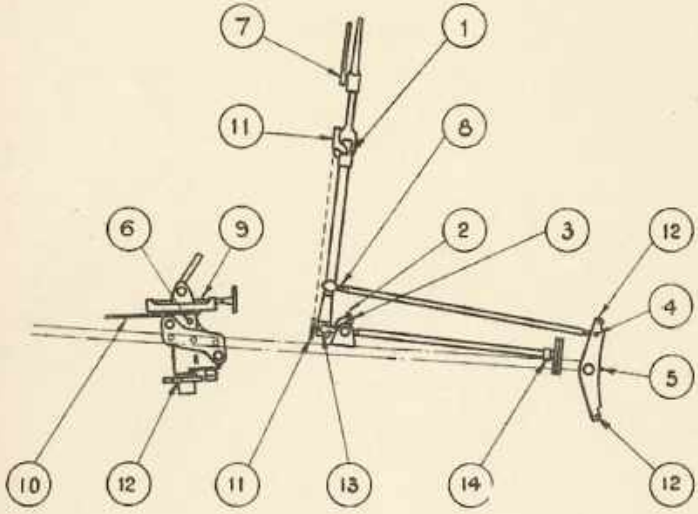
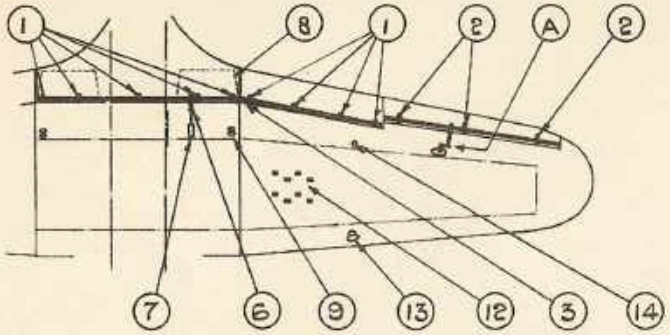
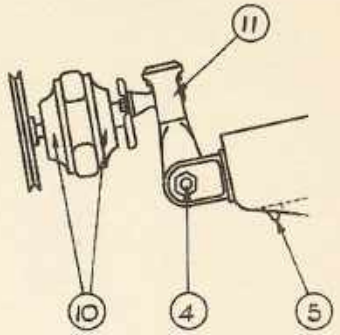
LUBRICATION-TAIL UNIT AP 1564A VOL. 1. SECT. 3 FIG. 3



REF.	LOCATION	No. OF PTS.	LUBRICANT
1	CONTROL COLUMN JOINT	1	
2	UNIVERSAL JOINT	1	
3	CRANK BEARINGS	2	
4	CONNECTING ROD REAR END	1	
5	ELEVATOR LEVER BEARING	1	
6	RUDDER BAR PEDESTAL	1	
7	BRAKE LEVER & PARKING CATCH PIVOTS	2	OILCAN
8	CONNECTING ROD FRONT END	1	
9	RUDDER BAR ADJUSTING GEAR.	SLIDE & SCREW	
10	RELAY VALVE CONTROL CONN^{G} ROD ENDS	2	OILCAN
11	CHAINS AND SPROCKETS	—	
12	CONTROL CABLE CONNECTING PINS	4	
13	CONTROL COLUMN BALL BEARINGS	2	
14	TORQUE TUBE BALL BEARING	1	

LUBRICATION AP. 1564A. VOL. I. SECT. 3 FIG. 4





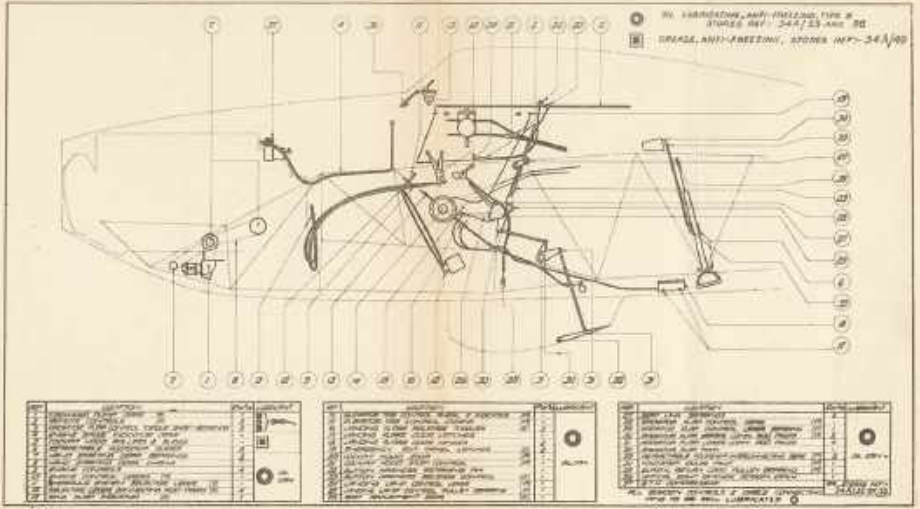
DETAIL AT "A"

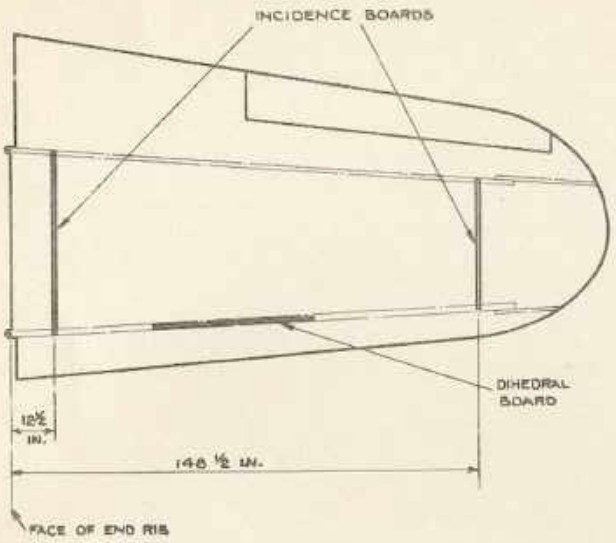
REF	LOCATION	Nº OF PTS	LUBRICANT
1	FLAP HINGES	13	
2	AILERON HINGE BOLTS	6	
3	FLAP SPAR UNIVERSAL JOINTS	2	
4	AILERON LEVER LINK PIVOT	2	
5	AILERON LEVER SWIVEL FORK	2	
6	FLAP LEVER JACK PIVOT	1	
7	FLAP JACK PIVOT	1	
8	FLAP GAP PANEL HINGE	2	OIL CAN
9	AILERON CABLE PULLEYS	4	
10	DIFFERENTIAL GEAR BALL BEARINGS	4	
11	AILERON LEVER LINK BALL UNIVERSAL	2	
12	GUN MOUNTINGS	10	OIL CAN
13	LANDING LAMP PIVOTS	4	
14	LANDING LAMP CONTROL WIRE PULLEY	2	

ALL CABLE CONNECTING PINS TO BE WELL LUBRICATED

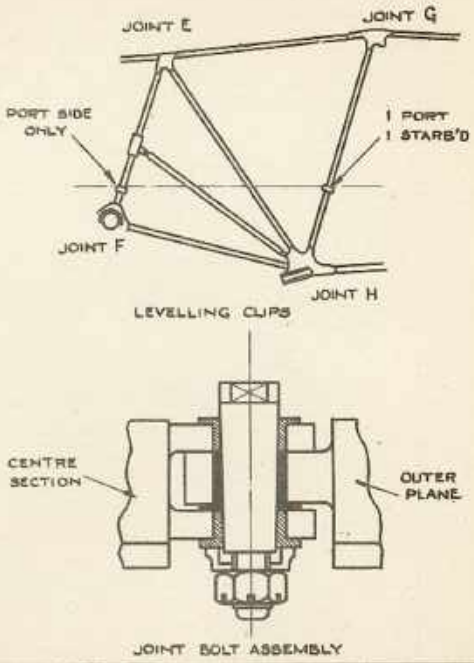
F.5/16.

LUBRICATION—MAIN PLANE AP 1564A VOL I. SECT. 3 FIG. 5





POSITION OF INCIDENCE & DIHEDRAL BOARDS



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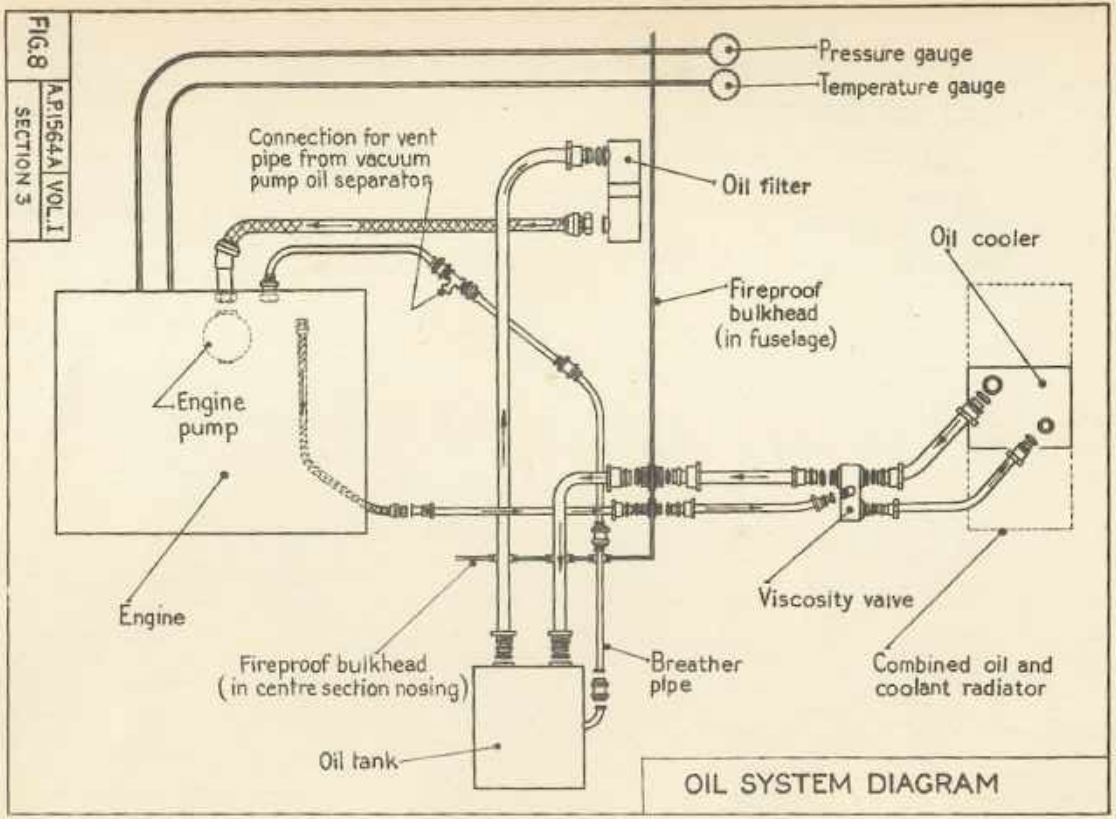
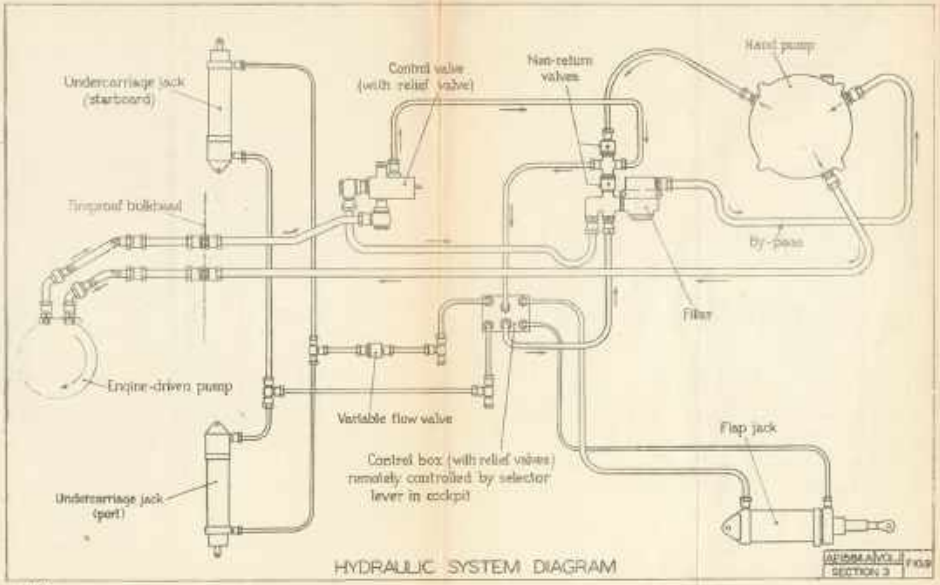
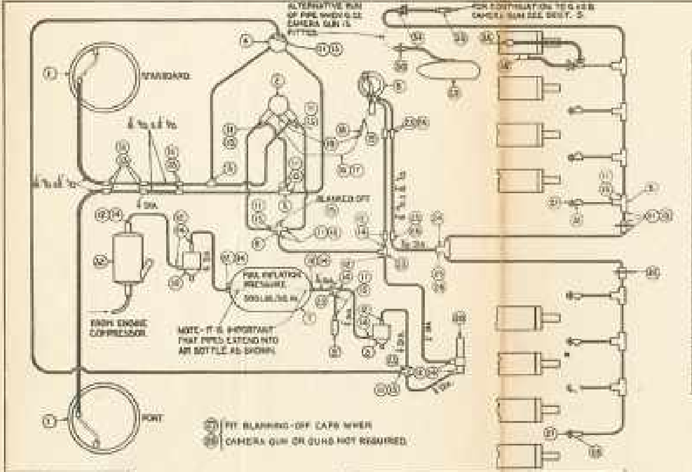
RIGGING DIAGRAM AP.1564A. VOL.I SECT.3 FIG.7



OIL SYSTEM DIAGRAM


Undercarriage jack (starboard)
Control valve (with relief valve)
Non-return valves
Hand pump
Tinned bulkhead
By-pass
Filter
Engine-driven pump
Variable flow valve
Flap jack
Control box (with relief valves) remotely controlled by selector lever in cockpit
Undercarriage jack (port)
HYDRAULIC SYSTEM DIAGRAM
AP1886A VOL 2
SECTION 3
FIG 9



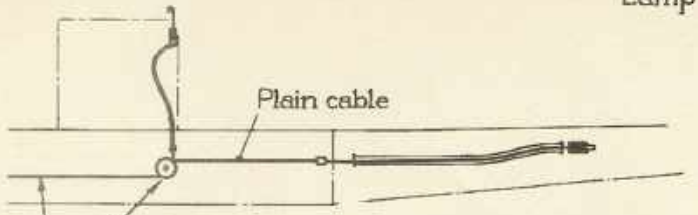
NO.	DESCRIPTION	DRG. NO.
1	WHEEL BRAKE UNITS [illegible]	[illegible]
2	DUAL RELAY VALVE CONTROL	[illegible]
3	AIR FILTER	[illegible]
4	TRIPLE PRESSURE GAUGE	[illegible]
5	T-PIECE [illegible]	[illegible]
6	FOUR-WAY PIECE [illegible]	[illegible]
7	AIR CONTAINER ([illegible] CAPACITY)	[illegible]
8	CONTROL RING	[illegible]
9	CHARGING CONNECTION	[illegible]
10	OIL TRAP	[illegible]
11	COUPLING OUTER SLEEVE [illegible]	[illegible]
12	COUPLING OUTER SLEEVE [illegible]	[illegible]
13	RUBBER SEALS [illegible]	[illegible]
14	RUBBER SEALS [illegible]	[illegible]
15	PLUG	[illegible]
16	BOWDENEX CABLE	
17	[illegible] FOR CABLE	[illegible]
18	CABLE ADJUSTER	
19	CABLE END FERRULES	
20	PRESSURE REDUCING VALVE, [illegible] TYPE	[illegible]
21	BULKHEAD CONNECTION	[illegible]
22	BULKHEAD CONNECTION	[illegible]
23	T-PIECE [illegible]	[illegible]
24	T-PIECE [illegible]	[illegible]
25	COUPLING OUTER SLEEVE [illegible]	[illegible]
26	RUBBER SEALS [illegible]	[illegible]
27	BLANKING OFF CAPS	[illegible]
28	BLANKING-OFF CAPS	[illegible]
29	B.S.A. CAMERA GUN UNIT	[illegible]
30	BULKHEAD CONNECTION [illegible] CAMERA GUN	[illegible]
31	T-PIECE	[illegible]
32	OIL RESERVOIR	
33	PNEUMATIC FIRING UNIT	[illegible]
34	BULKHEAD CONNECTION [illegible] CAMERA GUN	[illegible]
35	[illegible] UNIT FOR [illegible] GUNS	
36	[illegible] RELEASE UNIT [illegible]	[illegible]

NOTE -
PIPES NOT OTHERWISE MARKED ARE [illegible]

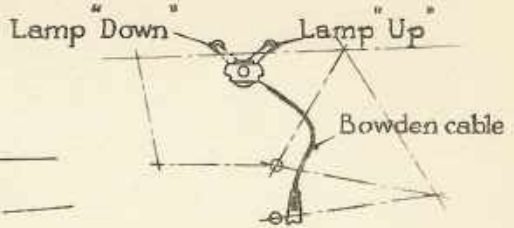
FIG. 10	A.P.1564A VOL.1
	SECTION 3

PNEUMATIC SYSTEM DIAGRAM

F.S./20

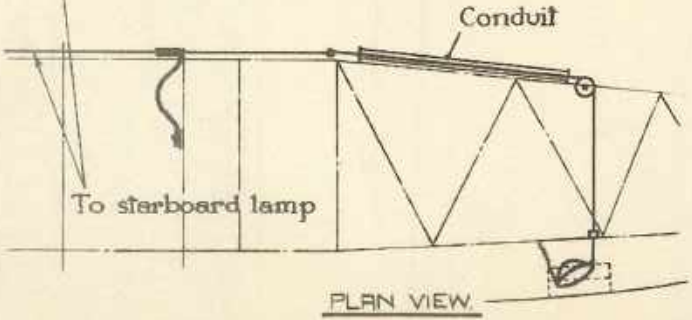


FRONT VIEW

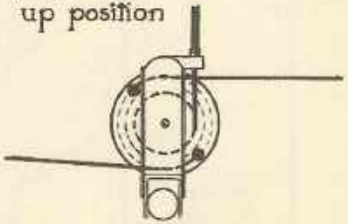


SIDE VIEW

The cables should be assembled as shewn with the cockpit control in the "up" position



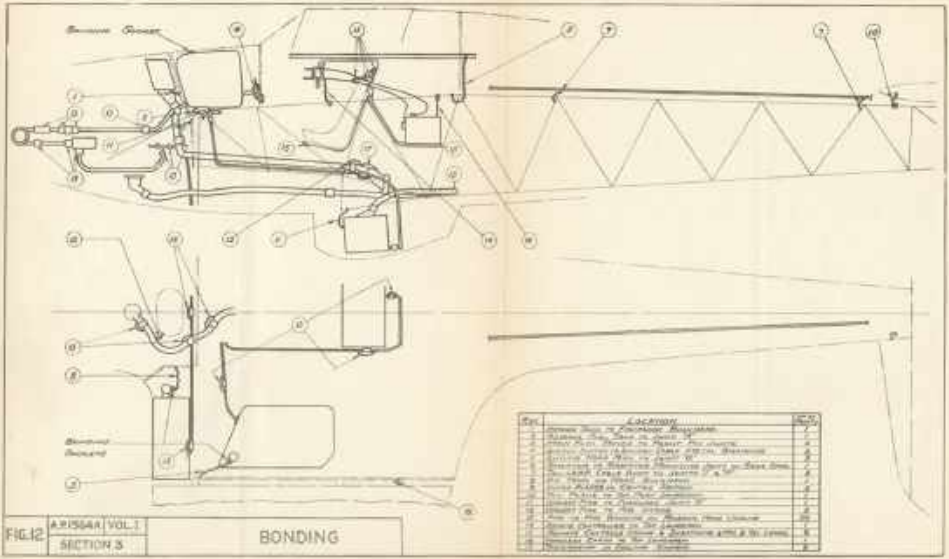
PLAN VIEW



Detail A

A.P.1564A VOL. I
SECTION 3
FIG. 11

LANDING LAMPS CONTROL



Ref.	Location	No. Off
1	Between Base of Fin and Rear Fuselage	1
2	Between Fin Spar Joints	1
3	Fin Spar Joints to Front Fuselage	2
4	Between Tailplane Rear Spar Joints	1
5	Tailplane Front Spar to Front Fuselage	2
6	Tailplane Rear Spar to Rear Fuselage	2
7	Between Tailplane Front & Rear Spar Joints	1
8	Fin Front Spar Joint to Tailplane Front Spar Joint	1
9	Fin Front Spar to Front Fuselage	1
10	Fin Rear Spar to Rear Fuselage	1
11	Between Fin Spar Joints	1
12	Between Fin & Tailplane Front Spars	1
13	Between Fin & Tailplane Rear Spars	1
14	Between Fin & Rear Fuselage	1
15	Fin Front Spar to Rear Fuselage	1
16	Between Fin & Rear Fuselage (Rear Closure)	20
17	Between Tailplane & Fin Leadings	1
18	Between Tailplane Front & Rear Spars & Fin Spars	4
19	Between Tailplane & Rear Fuselage	1
20	Between Fin & Rear Fuselage	1

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BONDING

SECTION 4

REMOVAL AND ASSEMBLY OPERATIONS

SECTION 4

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SECTION 4

REMOVAL AND ASSEMBLY OPERATIONS

General

1. Of the following paragraphs dealing with the removal and assembly of components, the majority refer to the removal of components and, providing additional or contrary instructions for assembly are not given, the procedure for assembly may be assumed to be the same as that for removal but in the reverse order.

Division for transport

2. For transport purposes, Hurricane I aeroplanes are packed in cases measuring internally 29 ft. 6 in. long x 9 ft. 6 in. wide x 8 ft. 3 in. high, each case containing one complete aeroplane with engine installed; the aeroplane is divided into the following units before being packed:-

(a) Airscrew
(b) Port outer plane
(c) Starboard outer plane
(d) Rudder
(e) Fin
(f) Tail plane and elevator
(g) Engine, fuselage and centre section

Instructions for assembling the aeroplane from these units will be found in the following paragraphs.

FUSELAGE

Engine

3. Removal. - (i) By raising the tail, set the aeroplane approximately in flying position and place chocks under the wheels to prevent fore-and-aft movement.

(ii) Turn the fuel distributing cock to the OFF position.

(iii) Drain the oil tank (see Sect.3, para.80).

(iv) Drain the cooling system (see Sect.3, para.86).

(v) Remove the airscrew (see Sect.3, para.20) and hub.

(vi) Remove the following cowling:-

(a) Engine and rear top-panels
(b) Engine and intermediate side-panels
(c) Front and intermediate under-panels
(d) Leading-edge fillet

(vii) Remove the stays supporting the arch cowl rail over the engine and then the arch cowl rail itself.

(viii) Remove the bolts attaching the vertical cowl rail to the horizontal top cowl rail and then remove the horizontal top cowl rail.

(ix) Remove the bolts attaching the lower cowl rail at each end and those attaching the nose collar diaphragm to the spigots on the engine mounting.

(x) Remove the nose collar and the lower cowl rail.

(xi) Remove the starter chains and the starter sprockets from the countershaft above the electric starter.

(xii) Remove the air intake at the flange at the rear of the engine.

(xiii) Disconnect the bonding wire to the coolant pipe.

(xiv) Remove the exhaust manifolds and the cooling pipes from the electrical generator.

(xv) Remove the pipe from the air compressor to the oil reservoir of the pneumatic system.

(xvi) Remove the drain pipes from the fuel pump and the supercharger.

(xvii) Remove the drain plug on the engine-driven pump of the hydraulic system and drain the fluid into a suitable receptacle.

(xviii) Remove the oil vent pipe between the engine connection and the T-piece.

(xix) Remove the large flexible inlet pipe between the engine oil pump and the oil filter and then the smaller flexible oil outlet pipe from the engine.

(xx) Remove the coolant pipe between the engine pump and the joint just forward of the centre section front spar.

(xxi) Disconnect the flexible inlet pipe and the pressure gauge banjo fitting at the engine fuel pump; tie the banjo fitting with cord to the nearest structural member, taking care to avoid sharp bends in the capillary tube.

(xxii) Disconnect the flexible pipe from the non-return valve at the carburettor T-piece.

(xxiii) Remove the priming pipe and the boost gauge pipe at their engine ends.

(xxiv) Disconnect the oil thermometer bottle and the oil pressure gauge banjo at the oil relief valve on the starboard side of the engine and tie them to the adjacent structure, care being taken to avoid sharp bends in the capillary tubes.

(xxv) Remove the flexible pipes at the engine-driven pump of the hydraulic system.

(xxvi) Disconnect the two leads at the accumulator in the fuselage and stow them at once on the dummy terminal block below the accumulator; access is through the door in the starboard side fairing. Note. - It is important that this disconnection is made before any other electrical leads are disconnected.

(xxvii) Disconnect the two leads from the electric starter motor; push down the rubber sleeves to uncover the connections.

(xxviii) Remove the ignition leads from the magnetos and the leads from the front end of the generator; stow the latter on the dummy terminal block on the engine mounting.

(xxix) Disconnect the throttle and mixture control rods at the levers on the engine; move the throttle control in the cockpit to the "closed" position.

(xxx) At the rear of the engine, remove the engine-speed indicator drive and the bowden cable from the boost cut-out lever; tie the latter to the adjacent structure.

(xxxi) Attach the engine hoisting sling to the engine (as detailed in A.P.1590B, Vol.I) and to the hoist hook, adjusting the hoist so that it just takes the strain; remove the engine holding-down bolts.

(xxxii) Hoist and swing the engine forward to clear, making sure that no fittings, cables, pipes, etc. are left in such a position that they impede the removal of the engine; lower the engine into a suitable cradle.

4. Installation. - The installation of the engine is the same as the removal procedure described in the previous paragraph, but in the reverse order; reference should also be made to the installation notes in A.P.1590B, Vol.I. The engine holding-down bolts should be assembled in the following manner:-

(i) Place a piece of packing (supplied with the engine) between each engine bearer and each engine foot; the rubber packings should be placed beneath the rear feet and the Ferobestos packings beneath the front feet.

(ii) At each of the front feet, first insert the rear bolt, with a washer in place under its head; screw it downwards into the engine bearers and pass the locking strip over the bolt head. Then fit a washer over each front bolt and pass each bolt upwards through the engine bearer, the packing, the engine foot, another washer, the rear bolt locking strip and finally through a third washer; screw a slotted nut on to each bolt and lock it with a split-pin.

(iii) At the rear feet, the two bolts for the port foot are 6¼ in. long under the head and those for the starboard foot are 5¼ in. long. Each of the four bolts should be fitted with a washer and passed up through the engine bearer, the lower packing, the engine foot, the upper packing, the capping strip and finally through a second washer; a slotted nut should then be screwed over each bolt and locked with a split-pin.

Engine and mounting

5. Removal. - (i) By raising the tail, set the aeroplane approximately in flying position and place chocks under the wheels to prevent fore-and-aft movement.

(ii) Turn the fuel distributing cock to the OFF position.

(iii) Drain the oil tank (see Sect.3, para.80).

(iv) Drain the cooling system (see Sect.3, para.86).

(v) Remove the airscrew (see Sect.3, para.20) and hub.

(vi) Remove the following cowling:-

(a) Engine and rear top-panels
(b) Engine and intermediate side-panels
(c) Intermediate under-panel
(d) Leading-edge fillet

(vii) Remove the stays supporting the arch cowl rail over the engine and the two fore-and-aft rails which support the intermediate under-panel.

(viii) Remove the exhaust manifolds and then the oil tank as described in Sect.3, para.81.

(ix) Remove the flexible pipes which run from the fuel filter to the engine pump and the carburettor.

(x) Remove the oil vent pipe between the engine connection and the T-piece.

(xi) Remove the large flexible inlet pipe between the engine oil pump and the oil filter and then the smaller flexible oil outlet pipe from the engine.

(xii) Remove the coolant pipe between the engine pump and the joint just forward of the centre section front spar.

(xiii) Remove the pipes of the hydraulic system which run between the engine-driven pump and the fireproof bulkhead.

(xiv) Remove the pipe from the air compressor to the oil reservoir of the pneumatic system.

(xv) Remove the boost gauge pipe between the engine and the fuel trap.

(xvi) From the engine mounting, remove the clips attaching the capillary tubes for the fuel pressure gauge, the oil temperature and the oil pressure gauges.

(xvii) From the engine mounting, remove the clips attaching the ignition leads and those attaching the electrical generator leads.

(xviii) Remove the cover plates on the fireproof bulkhead at fuselage joints A.

(xix) At their joints on the fireproof bulkhead, disconnect the horizontal top cowl rail and the fillet rail.

(xx) Disconnect the priming pipe at the engine connection and the pressure gauge banjo fitting at the engine fuel pump; tie the banjo fitting with cord to the nearest structural member, taking care to avoid sharp bends in the capillary tube.

(xxi) Disconnect the oil thermometer bottle and the oil pressure gauge banjo at the oil relief valve on the starboard side of the engine and tie them to the adjacent structure, care being taken to avoid sharp bends in the capillary tubes.

(xxii) Disconnect the two leads at the accumulator in the fuselage and stow them at once on the dummy terminal block below the accumulator; access is through the door in the starboard side fairing. Note. - It is important that this disconnection is made before any other electrical leads are disconnected.

(xxiii) At the starboard bottom rear strut of the engine mounting, disconnect the leads from the electric starter to the terminal block and the adjacent socket, also the lead from the push switch to the magnetic relay; tie these leads to the adjacent structure.

(xxiv) Remove the ignition leads from the magnetos and the leads from the front end of the electrical generator; tie the ignition leads to the engine mounting and the generator leads to the fireproof bulkhead.

(xxv) Disconnect the throttle and mixture control rods at the levers on the engine; move the throttle control in the cockpit to the "closed" position.

(xxvi) At the rear of the engine, remove the engine-speed indicator drive and the bowden cable from the boost cut-out lever; tie the latter to the adjacent structure.

(xxvii) Attach the engine hoisting sling to the engine (as detailed in A.P.1590B, Vol.I) and to the hoist hook, adjusting the hoist so that it just takes the strain; remove the engine mounting attachment bolts at joints A, port and starboard.

(xxviii) At the lower boom of the front centre section spar, remove the bolts attaching the lower rear struts of the engine mounting and the pins attaching the engine mounting bracing wires to the shackles; tie the bracing wires to the lower rear struts of the engine mounting.

(xxix) Swing the engine and mounting forward and hoist it away from the centre section, making sure that no fittings, cables, pipes etc. are left in such a position that they impede removal of the engine and mounting; lower the engine and mounting into a suitable cradle.

6. Installation. - The installation of the engine mounting complete with engine is the same as removal procedure described in the previous paragraph, but in the reverse order and with the following additions:-

(i) Set the fuselage in the rigging position (see Sect.3, para.9), using the jacking points at the lower ends of the compression legs.

(ii) Drop plumblines from the centre of the airscrew boss, the centre of joint U and the mid-point of the centre section front spar.

(iii) Adjust the bracing wires in engine mounting bay ZB until these three plumblines are in fore-and-aft alignment; the wires are provided with turnbuckles so that the wires themselves need not be turned.

Cockpit seat

7. Removal. - (i) At the lower end of the rear strap of the pilot's harness, remove the pin attaching the shackle to the bracket at the rear of the seat; the strap stop will come away and, to avoid loss, should be replaced on the shackle by means of the pin.

(ii) Remove the nuts attaching the harness strap links to the spigots on the sides of the seat and pull the rear harness strap up through the hole in the back of the seat; stow the harness out of the way.

(iii) Remove the split-pins locking the quadrant bolts to the bosses on the seat and remove the bolts, quadrants and distance tubes. Note. - The seat should not be supporting any load when the quadrant bolts are removed.

(iv) Remove the split-pins locking the spigots to the bosses on the seat and remove the bosses; the latter may be unscrewed by means of the flats provided on the outer flanges for a 9/16 in. spanner.

(v) Support the seat and remove the bolts attaching it at the upper brackets; lift the seat out of the cockpit.

Radiator flap

8. Removal. - (i) Disconnect the radiator flap control rods at the flap and operate the control lever in the cockpit until the indicator is in the CLOSED position; this latter operation will lift the control rods out of the way.

(ii) Cut the locking wires and remove the two bolts attaching each of the hinge pins at the forward end; withdraw the flap downwards and rearwards.

9. Assembly. - The installation procedure is the reverse of that for removal, but in addition the following points should be observed:-

(i) The hinge pin attachment bolts should be locked with 18 s.w.g. iron wire.

(ii) After assembly, set the control lever in the cockpit to the CLOSED position when the gap between the flap trailing edge and the fuselage underfairing should be 3½ in.; if this dimension is not obtained, the length of the flap control rods must be adjusted.

(iii) The length of the flap control rods may be adjusted by slackening the locknuts at their upper ends, disconnecting the fork-ends and screw them in or out as required. Access may be obtained through a door in the underfairing between the two control rods.

Radiator fairing

10. Removal. - See Sect.3, para.70.

11. Assembly. - See Sect.3, para.71.

MAIN PLANE

Gap fairing

12. Removal. - (i) With the flaps down (or removed), remove the locknut and fixing bolt attaching the upper main panel of the fairing to the upper rear panel; this bolt is situated on the inner side of the upper fairing above the universal joint between the flap spars.

(ii) Release the fixing of the lower main and rear panels in a similar manner.

(iii) Remove the three screws at the leading edge and thus remove the upper and lower main panels.

(iv) Remove the washer-head bolts attaching the upper and lower rear panels and thus remove these panels.

13. Assembly. - (i) Assemble the upper and lower main panels by means of three screws at the leading edge and secure the lower rear panel in position by means of the washer-head bolts.

(ii) Place the main fairing in position and bolt it to the lower rear panel with the fixing bolt, leaving approximately $\frac{3}{4}$ in. gap between the brackets.

(iii) Secure the upper rear panel in position by means of the washer-head bolts and bolt it to the main fairing with the fixing bolt.

(iv) Tighten the upper fixing bolt, and adjust the lower fixing bolt to suit, until the fairing is in contact with the skin of the outer plane and centre section at all points; lock the fixing bolts by means of the locknuts.

Flaps

14. Removal. - (i) Lower the flaps and disconnect the flap jack at its attachment to the flap lever.

(ii) Uncouple the universal joints and disconnect the flap indicator control cable at its attachment to the eyebolt on the centre section flap spar.

(iii) Remove the radiator fairing (see Sect.3, para.70).

(iv) Remove the bolts attaching the centre bearing of the flap spar to the bracket mounted on the fuselage plan bracing struts.

(v) Remove the bolts attaching the remaining flap spar bearings to the centre section and outer plane ribs; remove the flaps.

15. Assembly. - The assembly procedure is the reverse of that for removal, but in addition the following points should be noted. To ensure accurate alignment with the flap spar, the bearings should be adjusted during assembly by means of the shims provided. The shims should be introduced between the bearings and the ribs of the centre section, any shims not so required being used as packing beneath the head of the corresponding bolt of the bearing. When inserting the bolt, care should be taken not to use undue force lest the fibre locking device in the nut be dislodged; it is advisable to see that the end of the bolt has a small amount of taper at the tip.

CENTRE SECTION

Removal

16. (i) First remove the engine mounting complete with engine as described in para.5 and then remove the following cowling:-

(a) Rear side panels
(b) Front and rear walkways
(c) Trailing-edge fillet
(d) Covering under trailing edge
(e) Cover strip at rear of wheel housing

(ii) Remove the fireproof bulkhead inboard of the oil tank, by removing the fibre blocks, the plates and fibre bushes at the oil vent pipe and the bolts holding the two portions together.

(iii) Fit a hoisting bar through the fuselage in the angle formed by struts AB and AD; attach the fuselage slinging gear and hook it to the hoist.

(iv) Fit the handling bar through the tube between fuselage joints Q and jack up the rear fuselage with an adjustable trestle.

(v) Close the isolating cock at the reserve fuel tank in the fuselage and drain the main fuel tanks in the centre section (see Sect.3, para.76).

(vi) Drain the oil cooler (see Sect.3, para.83) and the oil tank (see Sect.3, para.80).

(vii) Drain the hydraulic system by opening the drain cock at the engine-driven pump, removing the filler cap in the handpump casing as a vent and operating the handpump.

(viii) Remove the outer planes (see para.21).

(ix) Remove the bolts attaching the rear walkway support to the innermost trailing edge rib of the centre section; the support should be left attached to the cross tube.

(x) Remove the brackets on the centre section inner girder which support the fillet rail.

(xi) Remove the main fuel tanks from the centre section (see para.37) and the flying controls from the cockpit (see paras.32, 34, 35 and 36).

(xii) Remove the pipes between the main fuel tanks and the T-piece on the rear wall of the wheel housing.

(xiii) Remove the fuel pipe between the T-piece on the rear wall of the wheel housing and the 3-way cock on the port longeron at joint B.

(xiv) Remove the fuel pipe from the 3-way cock to the fuel filter connection at the front spar and then the vent pipes from the main fuel tanks.

(xv) Remove the underfairing and radiator fairing (see Sect.3, para.70).

(xvi) Remove the two oil pipes between the oil cooler and the viscosity valve.

(xvii) Remove the coolant pipes between the radiator and the joint just forward of the centre section rear spar, disconnect the remaining coolant pipe at the radiator.

(xviii) Remove the radiator (see Sect.3, para.82) and the oil cooler (see Sect.3, para.84).

(xix) From the port longeron just aft of joint F, remove the clip attaching the pipes from the flap jack.

(xx) Remove the pipes from each end of the air cylinder; the port pipe may be disconnected at the union adjacent to the cylinder and starboard pipe at the union to the rear of the mid-point of fuselage starboard strut AB.

(xxi) At joint F1, remove the bolt through the tubular rivet attaching the bracket which supports the T-piece in the gun-firing pipes of the pneumatic system.

(xxii) Remove the clips attaching the brake-operating pipes of the pneumatic system to the lower longeron just aft of joints B, port and starboard.

(xxiii) At the latches locking the undercarriage in the DOWN position, disconnect the leads from the micro-switches and remove the pin attaching the two springs to the pivot arm; remove the bolts attaching the pivot tube and push out the tube, leaving the bowden cables attached to the latch.

(xxiv) From the pulleys on the centre section, free the cables operating the undercarriage latch gear.

(xxv) Remove all clips attaching the cable ducts to the centre section structure.

(xxvi) At the electric fuel contents gauge on each main fuel tank, lift the wire clip and remove the socket which houses the leads from the indicator in the cockpit.

(xxvii) At the outer ribs, remove the fibre fairleads for the landing lamp control cables; withdraw the cables inboard, coil them and stow them out of the way.

(xxviii) Remove the bolts attaching the fireproof bulkhead to the front spar.

(xxix) Support joint F1 by means of a cable or c attached to any convenient point on the fuselage structure and remove the bolts attaching the joint to the rear spar.

(xxx) Disconnect the pipes (from the undercarriage jacks) at the T-pieces situated on the starboard side just above and to the rear of the centre section front spar.

(xxxi) At the control box of the hydraulic system, remove the pipes to the flap jack.

(xxxii) Disconnect the air-speed indicator tubes at the unions just outboard of joint F, port.

(xxxiii) Disconnect the cables from the terminal blocks on the top boom of the centre section outer girder and draw them back through the duct on the front face of the rear spar; remove the duct, coil the cables and stow them out of the way.

(xxxiv) Disconnect the control cable of the flap indicator at its attachment to the eyebolt on the centre section flap spar.

(xxxv) Remove the bolts attaching the rear heelboard support to the lower longeron; remove the rear heelboard support.

(xxxvi) Remove the undercarriage (see para.29).

(xxxvii) Support the centre section by means of adjustable trestles placed as close under the outer girders as practicable and slacken off the wires in bays BD and DF.

(xxxviii) Disconnect the struts in the inner bay of the centre section at joints B and F; swing the freed ends clear.

(xxxix) Remove the strut between the rear spar lower boom and joint H.

(xl) Remove the bolts securing the top booms of the spars to the fuselage at joints B and F.

(xli) Lower the trestles on which the centre section is now resting and hoist the fuselage until it clears, making sure that no fittings, cables, pipes etc. are left in such a position that they impede the removal of the centre section.

(xlii) Remove the centre section.

17. Assembly. - The installation procedure is the reverse of that given for removal but with the following additions:-

(i) Drop plumblines as when checking the rear fuselage (see Sect.3, para.11).

(ii) Drop plumblines from the mid-points of the front and rear spars.

(iii) Adjust the wires in bays BD and DF until the lines dropped from the spars are in fore-and-aft alignment with the other plumblines.

(iv) Adjust all control cables to the proper tautness; fit new split-pins and locking wires as required.

Front spar

18. Removal. - (i) Remove the engine mounting complete with engine (see para.5).

(ii) Sling the aeroplane from joints A (see para.16, sub-para.(iii)), or alternatively, place a trestle under a wooden beam supporting the fuselage across joints D.

(iii) Remove the outer planes (see para.21).

(iv) Remove the rear side panels and the front walkways; this cowling is additional to that removed under (i) above.

(v) Remove the leading edge fairing (see para.19) and the oil tank (see Sect.3, para.81).

(vi) Remove the oil filter from the front face of the front spar opposite joint B, starboard.

(vii) Remove the main fuel tanks from the centre section.

(viii) Remove the starboard top fairing angle.

(ix) Remove the fuel filter from the front face of the front centre section spar.

(x) Disconnect each end of the coolant pipe elbow which passes through the front centre section spar and remove the bolts attaching the flange on the elbow to the spar.

(xi) Remove the undercarriage (see para.29).

(xii) From the undersurface of each spar, remove the two screws securing each end of the lower boom of each outer girder; at the web bracing joints with the lower boom, remove the three bolts at the front joint and, at the rear joint, the three bolts and eyebolt.

(xiii) Remove the undercarriage latch gear from the channel section at the front end of each inner girder and disconnect the electrical leads from the micro-switches on the latch gear.

(xiv) Remove the pulleys (which carry the latch gear operating cables) from the brackets mounted on the spar stiffeners above the latches; stow the latch gears, cables and pulleys out of the way.

(xv) Remove the air cylinder (see Sect.3, para.55).

(xvi) Remove the web plate of the channel fitting attaching the inner girder to the front spar.

(xvii) Disconnect the port side fairing angle from the brackets on the front spar top boom.

(xviii) Slide the lower boom of the outer girder forwards out of the rear spar; should the boom be tightly held in place, it will be necessary to remove the outer trailing edge rib and tap the boom rearwards until it clears, using a mallet and a block of wood.

(xix) Dismantle the joint of the outer girder with the top boom of the front spar.

(xx) Dismantle the joint of the inner girder with the large channel fitting on the front spar.

(xxi) Support the front spar and remove the three bolts attaching the top boom at joints B, port and starboard.

(xxii) Lower the front spar to clear the spool fittings at joints B and remove forwards.

Leading edge fairing

19. Removal. - (i) Remove the cover over the starboard main fuel tank.

(ii) Remove the screws attaching the top edge of the fairing and the screw at the inboard lower corner.

(iii) Remove the four nuts, on the rear faces of the spar booms, which attach the two intermediate formers to the spar.

(iv) From each end former, remove the two bolts which attach these formers to the spar shear plates; remove the fairing in a forward direction.

Fuel tank covers

20. Assembly of new covers. - New covers are only drilled with a certain number of location holes and therefore the remaining holes must be drilled on assembly; there are eight attachment points on the upper cover and seven on the lower. The method of determining the positions of the holes for the attachment screws is as follows:-

(i) Into the plug and cap fittings on the face of the tank, screw the special marking studs (ref. Sect.3, para.4).

(ii) Apply the cover to the centre section and secure the edges to the fairing strips by a sufficient number of screws to hold it in place. Note. - On the starboard side only, the holes along the front edge of the top cover must be drilled on assembly; the positions of these holes may be determined by scribing from below, or by an adaption of the method outlined in this paragraph.

(iii) With a mallet, strike the covering at points above the special studs so that the points of the latter will mark the inner surface of the cover.

(iv) Remove the cover and, at the point marked by the studs, drill 3/8 in. diameter holes.

(v) Replace and secure the cover with 2 B.A. screws to the fairing formers, and with 2 B.A. countersunk screws and drawsunk washers to the tank plug-and-cap fittings.

OUTER PLANES

Removal

21. (i) Trestle the aeroplane until it is approximately in its flying position.

(ii) Remove the gap fairing between the centre section and the outer plane (see para.12) and, if the flaps have not been removed, uncouple the outer plane flap spar from the centre section flap spar.

(iii) Disconnect the two aileron cables and the landing lamp control cable at the gap between the outer plane and the centre section, immediately aft of the rear spar.

(iv) Disconnect the navigation and landing lamp leads at the terminal block on the centre section end rib; access may be obtained through a door in the upper surface of the centre section.

(v) When removing the port outer plane, disconnect the tubes to the pressure head and, if the outer planes are of the skin-stressed type, disconnect the pressure head heater lead at the terminal block on the centre section end rib.

(vi) Disconnect the pipe for the pneumatic gun-firing gear at the joint on the trailing edge portion of the inner end rib.

(vii) Disconnect the gun heating pipes and the electrical bonding wires at their joints just aft of the rear spars.

(viii) Screw the lifting brackets into the sockets provided in the undersurface of each outer plane (see Sect.3, fig.1) and bolt the lifting handles in place; place trestles under both outer planes to take the load off the pin-joints and to maintain the stability of the aeroplane when one outer plane has been removed.

(ix) Remove the nuts and washers from the main plane joint pins and extract the joint pins with the special extractor supplied.

(x) Ease the plane away by means of the lifting handles and, after removing the trestles out of the way, lower the plane on to a suitably padded support.

Assembly

22. (i) Trestle the aeroplane until it is in the rigging position (see Sect.3, para.9).

(ii) Support the outer plane on adjustable trestles so that the plug-ends at the root end of the outer plane are adjacent to and just below the fork-ends of the centre section.

(iii) Using the lifting brackets and lifting handles, offer the outer plane up to the centre section and insert three of the taper joint pins as far as they will go into the fork joints.

(iv) Drive in the fourth joint pin as far as it will go to align the holes in the plug-end and fork-end.

(v) Withdraw this latter joint pin and, with a special B.& S.No.9 taper reamer, open up the holes until the reamer is home up to the collar.

(vi) Insert and tap home the taper joint pin and assemble the special washer, nut, and split-pin (see Sect.3, fig.7).

(vii) Repeat the process at the other three joints in succession, taking front and rear joints alternately.

(viii) With the aid of the dihedral and incidence boards, check the rigging of the main plane in accordance with the rigging diagram (see Sect.3, fig.7).

(ix) Couple up the outer plane services uncoupled when the outer plane was removed (see para.21); remove the lifting handles and brackets.

(x) Replace the gap fairing between the centre section and the outer main plane (see para.13).

Aileron

23. Removal. - (i) At the aileron lever, uncouple the connecting rod between the aileron control gear and the aileron.

(ii) Remove the nuts from the aileron hinge bolts that pass through the aileron spar.

(iii) Remove the aileron, leaving the bolts attached to the outer plane.

TAIL UNIT

Removal

24. (i) Remove the metal fairing between the tail plane, fin and fuselage.

(ii) Disconnect the rudder control cables at the rudder lever.

(iii) Remove the elevator connecting rod and disconnect the control cables at each end of the elevator lever in the tail plane; access to the lower end of the lever is obtained by removing the port side panel in the tail bay fairing.

(iv) Remove the pulleys for the elevator control cables from the bracket on the rear face of the tail plane front spar and pull the elevator cables through the spar from the front; replace the pulleys.

(v) Open the Woods frames in the upper surface of the tail plane at the rear inner corner and disconnect the cables to the tail trimming flaps.

(vi) Remove the fairleads for the trimming flap cables situated in the web of the tail plane front spar and pull the cable through from the front; replace the fairleads but do not lock the nuts.

(vii) Disconnect the electrical lead to the tail navigation lamp at the terminal block on fuselage strut TU, port.

(viii) Remove the rudder, fin, elevator and tail plane (in that order) as described in paras.25, 26, 27 and 28 below.

Rudder

25. Removal. - After performing the necessary operations as described in para.24 above, proceed as follows:-

(i) Disconnect the wireless aerial at the rear insulator.

(ii) Disconnect the balance flap cables at the housing for the hinge bearing on the rudder post.

(iii) Detach each hinge by removing the two bolts holding it to the hinge bracket on the rear finpost.

(iv) Remove the rudder, taking care not to wrench the lead for the tail navigation lamp during withdrawal.

Fin

26. Removal. - After performing the necessary operations as described in paras. 24 and 25 above, proceed as follows:-

(i) Remove the four bolts attaching the lower end of the front finpost at fuselage joint S1, and also the packing washers.

(ii) Detach the front finpost from fuselage cross strut RR by withdrawing the two bolts sufficiently to clear the packing block on the strut and to permit the removal of the shims (if any); the bolts should be left in the finpost to keep the distance tubes in place.

(iii) Detach the rear finpost from the rear end of the top longerons by withdrawing the four attachment bolts and removing the shims (if any); as in sub-para.(ii) above, the bolts should only be withdrawn sufficiently to clear the fittings on the fuselage.

(iv) Remove the four bolts attaching the bottom end of the rear finpost; lift the fin upwards and remove it clear of the fuselage.

(v) Push home the two bolts left in the front finpost (see sub-para.(ii)) and the four bolts in the rear finpost (see sub-para.(iii)) and replace the nuts.

Elevator

27. Removal. - After performing the necessary operations as described in paras.24, 25 and 26 above, proceed as follows:-

(i) Remove the control cable fairleads for the tail trimming flap from the front face of the tail plane rear spar; access is obtained through the Woods frames in the upper surface of the tail plane at the rear inner corner.

(ii) Detach each hinge by removing the two bolts holding it to the hinge bracket on the tail plane rear spar.

(iii) Remove the elevator in a rearward direction, taking care that the connectors on the trimming flap cables do not foul the tail plane rear spar.

(iv) If necessary, remove the bolt connecting the two half-elevators; each half-elevator may be removed separately if required.

Tail plane

28. Removal. - After performing the necessary operations as described in paras.24, 25, 26 and 27 above, remove the four bolts attaching the tail plane to the fuselage at joints R and T, port and starboard, and lift the tail plane clear.

ALIGHTING GEAR

Undercarriage

29. Removal. - (i) With the undercarriage in the DOWN position, jack up the aeroplane until the wheels are just clear of the ground.

(ii) Disconnect the hydraulic jack by removing the bolt attaching it to the triangulated lever on the sidestay; replace the bolt, nut and washer in the lever and tie the free end of the jack to the channel fitting on the centre section spar.

(iii) Disconnect the assisting spring gear at its attachment to the shackle on the sidestay; care should be taken to hold the lower portion of the gear and allow it to ease off to its full extension gradually.

(iv) Disconnect the sidestay at the compression leg by removing either one of the two bolts.

(v) Remove the compression leg fairing by withdrawing the bolts attaching the fairing clips and removing the clips.

(vi) Disconnect the radius rod at the compression leg by removing the bolt; swing the free end upwards and tie it to any convenient part of the centre section structure.

(vii) Release the pressure in the pneumatic system by depressing the valve at the charging connection and, at the upper end of the compression leg, uncouple the lower end of the flexible tube from the pipeline running down to the brake unit; remove the clip attaching the end of the flexible tube to the air valve on the compression leg.

(viii) Remove the split-pin locking the special ball nut for the assisting spring on the compression leg pivot bolt.

(ix) Whilst supporting the compression leg and assisting spring gear, unscrew and withdraw the pivot bolt; remove the compression leg and the assisting spring gear.

(x) At the joint of the sidestay with the inner girder, remove the split-pin and the slotted nut at the rear end of the pivot bolt and withdraw the bolt; the head of the bolt is on the front face of the front spar lower boom.

(xi) Whilst supporting the sidestay, wedge the end of a piece of wood into the bore of the pivot distance piece and withdraw the distance piece rearwards; remove the sidestay.
Note. - If required, the sidestay may be disconnected at the elbow joint.

Assembly

30. When assembling the undercarriage care must be taken to ensure full freedom of movement without undue slackness in the joints.

(i) Assemble the two portions of the sidestay if they have been disconnected at the elbow joint. Test for freedom of movement by holding the lower portion upwards and allowing the upper portion to fall; the upper portion should just be capable of swinging downwards under its own weight.

(ii) Assemble the upper end of the sidestay assembly on the fitting at the inner girder joint with the front spar; note that the thin washer should be placed under the bolt head on the front face of the spar boom.

(iii) Test the sidestay assembly for freedom of movement; when raised and allowed to fall, it should fall freely under its own weight but there should not be any sideplay.

(iv) Offer up the compression leg (axle inboard) to the forked sleeve at the front end of the lower boom of the centre section outer girder and insert the pivot bolt from the outboard side.

(v) Remove the locking plate on the inboard side of the forked upper end of the compression leg and place the large washer over the end of the pivot bolt.

(vi) Screw the special ball nut for the assisting spring gear on to the end of the pivot bolt; tighten the nut and lock it in place with a split-pin. (It is unnecessary to separate the assisting spring gear from the ball nut).

(vii) Replace the locking plate, turning the pivot bolt by its head (if necessary) to ensure that the ball nut fits inside the locking plate with the ball uppermost.

(viii) Swing the compression leg fore-and-aft and sideways to test for freedom of movement; should there be too much play in the universal sleeve on the outer girder boom, the sleeve must be replaced.

(ix) Attach the radius rod to the compression leg; the bolt head should be on the inboard side.

(x) Raise the locking latch assembly and tie it back clear of the sidestay triangulated lever to avoid damage.

(xi) Attach the sidestay to the compression leg.

(xii) Attach the lower end of the assisting spring gear to the shackle on the sidestay.

(xiii) At the upper attachment of the assisting spring gear, set the ball on the ball nut aft to the limit allowed by the locking plate, i.e. 3° approximately; this may be done by turning the pivot bolt.

(xiv) With the undercarriage retracted, check to ensure a small clearance between the upper end of the assisting spring gear and the spar plate; lock the locking plate attachment bolt.

(xv) Attach the hydraulic jack to the fork at the top of the sidestay triangulated lever, making sure that the flat faces of the fork face inboard.

(xvi) Lower the locking latch assembly into position. There should be a clearance of 0.03 in. between the end of the latch gear tube and the face of the fork; in plan view, the centre line of the latch gear tube should line up with the centre of the front cheek of the fork.

(xvii) Attach the fairing to the compression leg.

(xviii) Test the undercarriage for freedom of movement. Raise the undercarriage by selecting WHEELS UP and operating the handpump; set the selector lever to WHEELS DOWN and the undercarriage should fall under its own weight (<u>see</u> also Sect.3, para.36).

Tail wheel unit

31. Removal. - (i) Trestle the aeroplane until the tail wheel is clear of the ground.

(ii) Remove access panel in the port side of the tail bay fairing and disconnect the tail wheel compression leg at its upper fixing by removing the securing bolt.

(iii) At the lower fixing, remove the wire locking the four bolts for the securing cap; remove the four bolts and withdraw the tail wheel unit downwards.

(iv) Unless the tail wheel unit is to be replaced immediately, it will be advisable to remove the V-strut assembly that provides the upper fixing point for the compression leg; this is effected by removing a bolt at fuselage joints R, port and starboard.

FLYING CONTROLS

Control column assembly

32. Removal. - (i) Remove the intermediate and rear side cowling panels.

(ii) Remove the cockpit seat (see para.7).

(iii) From the heelboards, remove the screws attaching the pipe connections of the pneumatic system; the nuts are fixed in the brackets so detached.

(iv) Remove the heelboards; whilst the attachment screws are being removed, the 4 B.A. nuts may be held against rotation by inserting a box spanner through the holes in the underside of the heelboard support tubes.

(v) Disconnect the elevator control tube at both ends and remove it.

(vi) Disconnect the brake control bowden cable at the lever on the control column; hold the lever forward and, with a suitable instrument inserted in the slot at its base, lift the cable nipple clear and slide the cable out through the slot.

(vii) Remove the clips attaching the bowden cable and the rubber tubes of the pneumatic system to the control column; coil the cable and stow where convenient.

(viii) Disconnect the rubber tubes at their upper ends and tie them out of the way to the mounting tube of the control column assembly.

(ix) Disconnect the aileron torque tube at the universal joint at the bottom of the control column.

(x) From the control column mounting tubes, remove the bolts attaching the crank bearing brackets.

(xi) Remove the control column assembly with the bearing brackets. As soon as the bearing brackets are clear, slip them off the cranks and replace them on the mounting tubes; replace the attachment bolts, screwing on the nuts finger tight only. Care should be taken to prevent the distance tubes within the mounting tubes from falling out of position.

33. Installation. - The installation procedure is the reverse of that for removal but the following point should be observed. When re-assembling the cranks in the bearings, a laminated brass shim ($1\frac{1}{8}$ in. o/d x $\frac{13}{16}$ in. i/d x $\frac{1}{64}$ in. thick) should be fitted between the inner faces of the bearings and the shoulders of the cranks to take up possible end play.

Cockpit aileron controls

34. Removal. - After carrying out the operations described in para.32, sub-paras. (i) to (iv) inclusive, proceed as follows:-

(i) At the rear end of the aileron torque tube, disconnect the aileron cables at the turnbuckles immediately outboard of the cable drum.

(ii) Remove the three bolts attaching the housing for the torque tube bearing to the support bracket on the centre section rear spar.

(iii) Remove the torque tube, complete with cable drum; replace the bolts removed under (ii) above to retain the cable guard.

Cockpit elevator controls

35. Removal. - After carrying out the operations described in para.32, sub-paras. (i) to (iv) inclusive, proceed as follows:-

(i) At the ends of the elevator lever countershaft, remove the caps of the rudder cable fairleads; remove the cables and replace the caps.

(ii) Disconnect the elevator cables at each end of the elevator lever and stow the freed ends out of the way.

(iii) At the rear end of the flying controls mounting tubes, remove the bolts attaching the supporting plug-ends for the elevator lever countershaft.

(iv) Remove the complete countershaft assembly by withdrawing it rearwards.

Rudder bar assembly

36. Removal. - After carrying out the operations described in para.32, sub-paras. (i) to (iv) inclusive, proceed as follows:-

(i) At the rudder lever, disconnect the rudder cables and uncouple the connecting rod to the brake relay valve of the pneumatic system; the shackle should remain with the connecting rod.

(ii) Remove the bolts attaching the front heelboard support tubes to the bottom longeron; remove the support tubes.

(iii) Remove the bolts attaching the rudder pedestal support tubes to the pedestal and to the brackets on the flying controls mounting tubes.

(iv) Remove the pedestal support tubes, taking care to avoid damage should it be found necessary to drive them with a hammer.

(v) Turn the rudder bar fore-and-aft as far as possible and lift out the complete assembly.

FUEL SYSTEM

Main fuel tank

37. Removal. - (i) Remove the upper and lower tank covers and drain the tank (see Sect.3, para.76).

(ii) At the electric fuel gauge, lift the wire clip and withdraw the socket which houses the leads from the indicator in the cockpit.

(iii) Disconnect the fuel pipe from the cock situated in the inboard lower edge of the tank.

(iv) Disconnect the vent pipe at the connection in the front upper edge of the tank, holding the pipe connection at the tank against rotation by a $\frac{7}{16}$ in. spanner fitted over the flats provided.

(v) Disconnect the bonding wire from the socket fitting at the filler cap seating by removing the attaching screw.

(vi) Remove the bolts by which the two struts that pass through the tank are attached to the joints on the centre section structure.

(vii) Remove the locking wire, bolt, washer and rubber pad from each of the four tank feet.

(viii) Lift the tank out vertically, taking care to see that the struts through the tank do not foul the centre section structure or damage the tank.

(ix) Remove the struts and, to avoid loss, replace the rubber pad, washer and bolt.

38. Installation. - The installation procedure is the reverse of that for removal but the following points should be noted. The rubber pads should be arranged so that one is under

each tank foot, and one between the tank foot and the washer under the bolthead; the bolts should be locked with wire.

Reserve fuel tank

39. Removal. - (i) Remove the rear top and intermediate side cowling panels.

(ii) Remove the bolts attaching the rearmost portions of the horizontal top cowl rails; remove these cowl rails.

(iii) Set the handle of the fuel distributing cock in the cockpit to the OFF position.

(iv) Cut the wire locking the isolating cock at the reserve tank sump in the ON position and turn the cock to the OFF position.

(v) Disconnect the fuel pipe at this cock and move the freed end out of the way.

(vi) Place a funnel (to which is attached a length of hose) under the cock; turn the cock to the ON position and drain the fuel into a suitable receptacle.

(vii) On the port side, disconnect the vent pipe in the undersurface of the tank, holding the pipe connection at the tank against rotation by a ⅜ in. spanner fitted over the flats provided.

(viii) Disconnect the priming pipe at the top of the rear face of the tank by removing the nut and sliding off the banjo.

(ix) At the electric fuel gauge, lift the wire clip and withdraw the socket which houses the leads from the indicator in the cockpit.

(x) Disconnect the bonding wire from the outer web of the port front foot.

(xi) At each of the four tank feet, remove the slotted nuts and bolts holding the four clamps closed; swing the clamps clear and lift the tank out vertically.

OIL SYSTEM

Oil tank

40. Removal. - See Sect.3, para.81.

41. Assembly. - See Sect.3, para.82.

Oil cooler

42. Removal. - See Sect.3, para.84.

Oil filter

43. Removal. - (i) Drain the oil tank (see Sect.3, para.80).

(ii) At the bottom of the filter, uncouple the flexible pipe to the engine.

(iii) At the top of the filter, uncouple the pipe to the tank; disconnect the other end of the pipe at the tank and move the filter end of the pipe clear of the filter.

(iv) Support the filter and remove the bolts attaching the bracket cap; remove the filter.

Viscosity valve

44. Removal. - (i) Place a suitable receptacle beneath the viscosity valve to catch the oil liberated when the pipes are disconnected.

(ii) Disconnect and remove the two pipes between the oil cooler and the viscosity valve.

(iii) At the viscosity valve, disconnect the two pipes from the fireproof bulkhead.

(iv) Remove the two bolts attaching the viscosity valve to the bracket on fuselage strut FH1.

45. Installation. - The installation procedure is the reverse of that for removal. To ensure the correct attitude of the valve on the strut, the bolts attaching the valve to the mounting should not be tightened until all four pipes are connected to the valve.

COOLING SYSTEM

Radiator

46. Removal. - See Sect.3, para.92.

Header tank

47. Removal. - See Sect.3, para.90.

48. Assembly. - See Sect.3, para.91.

HYDRAULIC SYSTEM

General

49. Absolute cleanliness is essential for the satisfactory operation of the system and, therefore, when pipelines are disconnected, the ends of the pipes must be protected against the entry of dirt. When it is desired to retain the fluid for further use, the receptacle into which it is drained must be scrupulously clean; mineral oil or grease may injure the gland and jointing compositions employed in the

system. Care should be taken that the fluid is not spilled as it may remove the protective coating from parts with which it comes in contact.

Control valve

50. Removal. - (i) Disconnect the pipes at the two banjo fittings and the smaller pipe entering the valve from above.

(ii) Remove the two bolts attaching the valve to the bracket on fuselage strut CD.

(iii) Remove the two bolts attaching the operating lever bracket to the valve; the valve may then be removed downwards.

Filter

51. Removal. - (i) Disconnect the outlet pipe from the top of the handpump at the non-return valve above the cruciform 4-way piece; disconnect the two pipes below this non-return valve at the front and rear sides of the cruciform 4-way piece.

(ii) Disconnect the two pipes coupled to the underside of the special 4-way piece attached to the side of the filter.

(iii) Unscrew and remove, from the special 4-way piece as one unit, the two non-return valves and cruciform 4-way piece; unscrew and remove the special 4-way piece from the filter.

(iv) Disconnect the outlet pipe at the filter and remove the two bolts attaching the filter to the bracket on the fuselage strut EH.

Handpump

52. Removal. - (i) Disconnect the outlet and inlet pipes in the upper part of the casing and then the outlet pipe at the bottom of the casing; a hose and funnel should be held in readiness to convey the fluid into a suitable receptacle.

(ii) Slacken off the bolt clamping the handle to the pump-operating shaft and remove the handle.

(iii) Support the pump casing and remove the bolts attaching it to the brackets on fuselage struts EF, EH and FCH; remove the pump casing.

Control box

53. Removal. - (i) Uncouple the two connecting rods from the selector gear.

(ii) Disconnect the six pipes entering the rear face of the control box; a hose and funnel should be held in readiness to convey any fluid into a suitable receptacle.

(iii) Remove the four bolts attaching the control box to its bracket when the control box may be removed downwards.

Selector gear

54. Removal. - (i) Disconnect the connecting rods to the control box and the cables operating the catch and latch gears; remove the instruction plate by removing three screws.

(ii) Remove the two bolts attaching the selector gear mounting bracket to fuselage strut CF.

(iii) Remove the three bolts attaching the selector gear spindle to the mounting bracket; the outer portion of the bracket will then drop away and the selector gear may be removed.

Jacks

55. Removal. - (i) Disconnect the two pipes at the jack and drain off the fluid into a suitable receptacle.

(ii) Disconnect the jack at each end.

PNEUMATIC SYSTEM

Oil reservoir

56. Removal. - (i) Detach the upper air pipe and drain the reservoir (see Sect.3, para.54).

(ii) On the rear face of the fireproof bulkhead, remove the four nuts and washers attaching the U-bolts and then withdraw the U-bolts from the front face of the fireproof bulkhead.

(iii) Remove the reservoir and the block on which it is mounted.

57. Installation. - The installation procedure is the reverse of that given for removal but instead of draining the reservoir it should be filled as described in Sect.3, para.53.

Oil trap

58. Removal. - (i) Drain the oil trap as described in Sect.3, para.51 and detach the two air pipes.

(ii) With a C-spanner, unscrew and remove the top half of the trap.

(iii) Slacken off the bolt closing the supporting bracket and withdraw the trap downwards.

Air cylinder

59. Removal. - See Sect.3, para.55.

Air filter

60. Removal. - See Sect.3, para.57.

Brake relay valve

61. Removal. - (i) Detach the four air pipes and uncouple the connecting rod to the rudder bar at the relay valve lever.

(ii) Remove the moulded cover by pulling it off against its retaining spring clips.

(iii) Remove the small spring clip from the cylindrical fitting connecting the bowden inner cable to the operating chain.

(iv) Raise the cable connector by depressing the brake lever on the spade grip of the control column, hold the connector in the raised position, release the brake lever and slide the cable and ball end out of the connector; replace the spring clip on the connector.

(v) Slacken the locknut and remove the bush which provides the adjustment for length of the bowden cable and is screwed into the frame of the relay valve; withdraw the bowden cable.

(vi) Remove the four bolts attaching the relay valve to the bracket when the valve may be removed.

62. Installation. - The installation procedure is the reverse of that given for removal but care should be taken that the cylinders project forward and to port and that the starboard cylinder is approximately 10^{0} to port of a fore-and-aft line; the attachment bolts will then secure the valve in its correct position.

SECTION 5

ELECTRICAL INSTALLATION

SECTION 5

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SECTION 5

ELECTRICAL INSTALLATION

INTRODUCTION

1. The diagrams issued with this Section are provided to assist in following the various electrical services. The circuits have been numbered in accordance with the fuse position. For example, the first fuse in the 8-way box is in the reflector gun sight circuit, this circuit has therefore been numbered 1. The various terminal blocks have also been numbered with the prefix T.B., and where the same terminal block occurs on one or more diagrams, it bears the same number.

2. Alternative circuits are shown in figs.4,5 and 12. The dotted circuits illustrate the manner in which some existing aeroplanes may be wired, while the full-line circuits illustrate how future aeroplanes will be wired. In fig.5 two types of undercarriage indicator are shown. To change over from one to the other, all that is necessary is to connect the cable from the numbered terminal of the old type indicator to the corresponding lettered terminal of the new type of indicator.

3. Referring to fig.4, the dotted circuit refers to aeroplanes wired for G.42 cine camera gun, while the full-line circuit illustrates aeroplanes wired for G.42B cine camera gun. An examination of fig.4 will show the manner in which the two circuits differ. If a septocel 7 cable is used, in which one of the cores is brown, this core must be connected to the terminal to which the slate-cored cable is shown connected.

4. Two dimmer switches type D are shown on fig.12. The old type D is now obsolete and will be replaced in future by the new type D. It should be noted that both old and new type D dimmer switches bear the same Stores Ref. number. The manner in which the new type of dimmer switch may be adapted to the existing wiring is shown in the illustration.

5. The location diagram, fig.1, shows the physical position of all the terminal blocks, and some of the remaining electrical equipment. The schematic diagram shows at a glance the source of supply for the various services. For example, it will be seen that the landing lamps are connected directly across the accumulator, whereas the navigation lamps are connected across the generator positive and negative. The generator controls circuit, fig.3, illustrates how the main terminal blocks are connected back to the generator or the accumulator as the case may be. The remaining circuits are self explanatory.

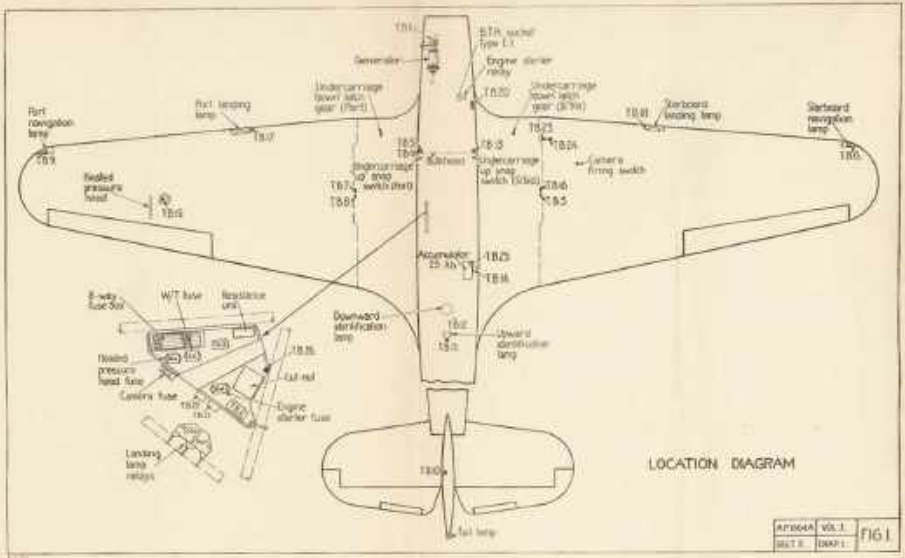

T.B.D.
R.T.H. socket type C.1
Generator
Engine starter relay
T.B.20
Port navigation lamp
T.B.9
Port landing lamp
T.B.17
Undercarriage down latch gear (Port)
T.B.2
T.B.4
Undercarriage up and down switch (Port)
T.B.7
T.B.8
Undercarriage down latch gear (Stbd)
T.B.22
Undercarriage up and down switch (Stbd)
T.B.3
T.B.23
T.B.24
T.B.6
T.B.5
Starboard landing lamp
T.B.21
Starboard navigation lamp
T.B.10
Camera firing switch
Heated pressure head
T.B.16
Accumulator 25 Ah
T.B.13
T.B.14
8-way fuse box
W/T fuse
Resistance unit
T.B.15
Heated pressure head fuse
Cut-out
Camera fuse
T.B.11
T.B.12
Engine starter fuse
Downward identification lamp
T.B.18
T.B.19
Upward identification lamp
Landing lamp relays
T.B.D.
Tail lamp
LOCATION DIAGRAM
AP.1564A
VOL. 1.
SECT. II
DIAG. 1.
FIG 1.

FIG 2

AIRBORNE RADIO SETS SHORT

SCHEMATIC DIAGRAM OF ELECTRICAL SERVICES

Generator controls, see Fig 3.

Engine starting, circuit 11, see Fig 7.

Landing lamps, circuits 5 & 6, see Fig 9.

W/T supply, circuit 12, see Fig 7.

Reflector gun sight, circuit 1, see Fig 12.

Instrument lamps, circuit 2, see Fig 11.

Navigation lamps, circuit 3, see Fig 10.

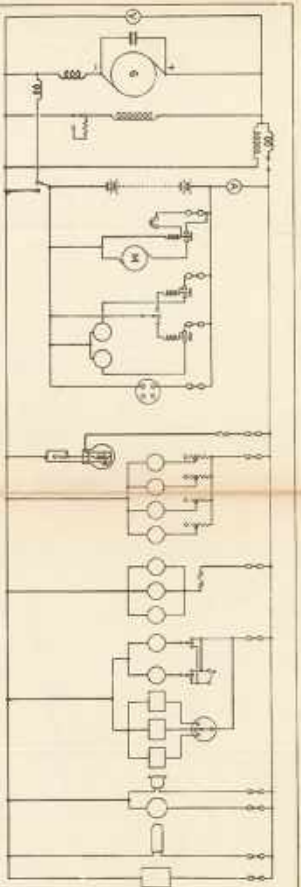
Identification lamps, circuit 4, see Fig 6.

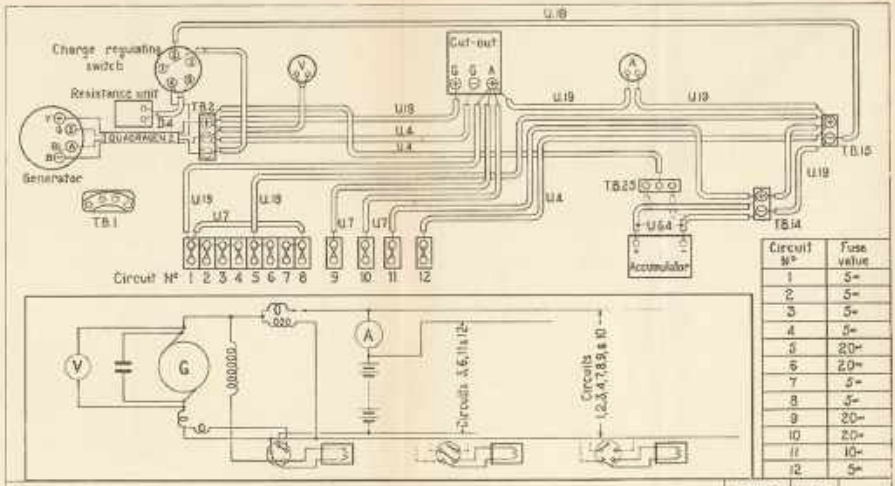
Fuel gauges, circuit 4, see Fig 6.

Undercarriage indicator, circuit 8, see Fig 5.

Heated pressure head, circuit 9, see Fig 8.

Camera supply, circuit 10, see Fig 4.





Circuit Nº	Fuse value
1	5-
2	5-
3	5-
4	5-
5	20-
6	20-
7	5-
8	5-
9	20-
10	20-
11	10-
12	5-

GENERATOR CONTROLS CIRCUIT

A.P.1564A	VOL.1	FIG.3
SECT. 5	CHAP.1	

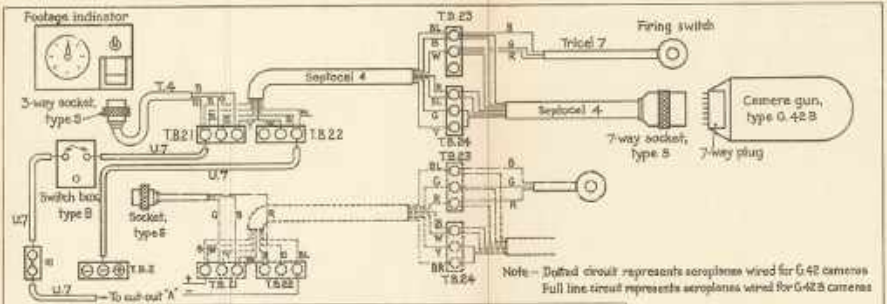
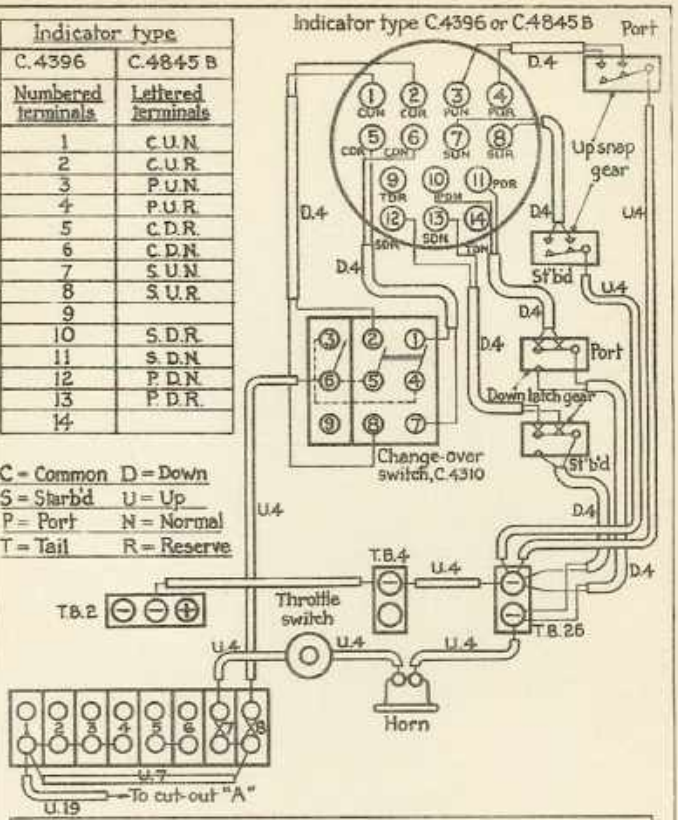


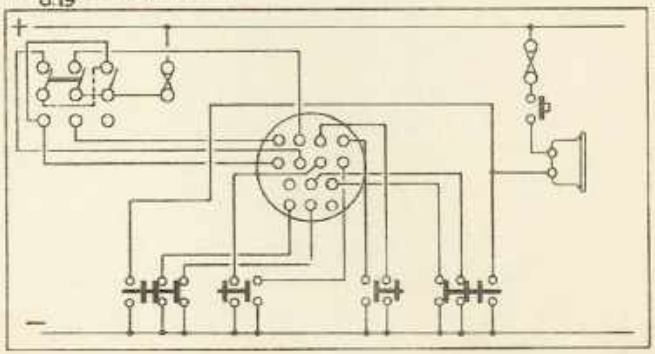
FIG. 4	A.P.1564A	VOL. I
	SECT. 5	CHAP. I

CINE CAMERA GUN CIRCUIT

Indicator type	
C.4396	C.4845 B
Numbered terminals	Lettered terminals
1	C.U.N.
2	C.U.R.
3	P.U.N.
4	P.U.R.
5	C.D.R.
6	C.D.N.
7	S.U.N.
8	S.U.R.
9	
10	S.D.R.
11	S.D.N.
12	P.D.N.
13	P.D.R.
14	

C = Common D = Down
S = Starb'd U = Up
P = Port N = Normal
T = Tail R = Reserve





UNDERCARRIAGE POSITION INDICATOR	A.P.1564A	VOL. I	FIG. 5
	SECT. 5	CHAP. 1	

FS/6

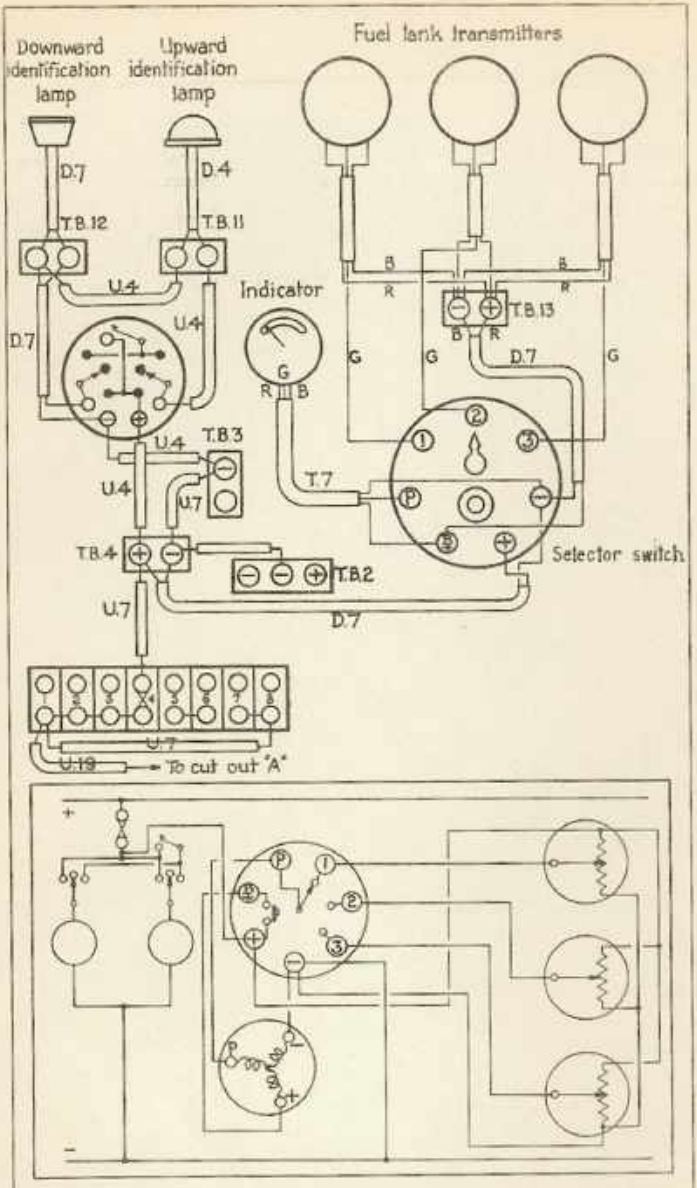
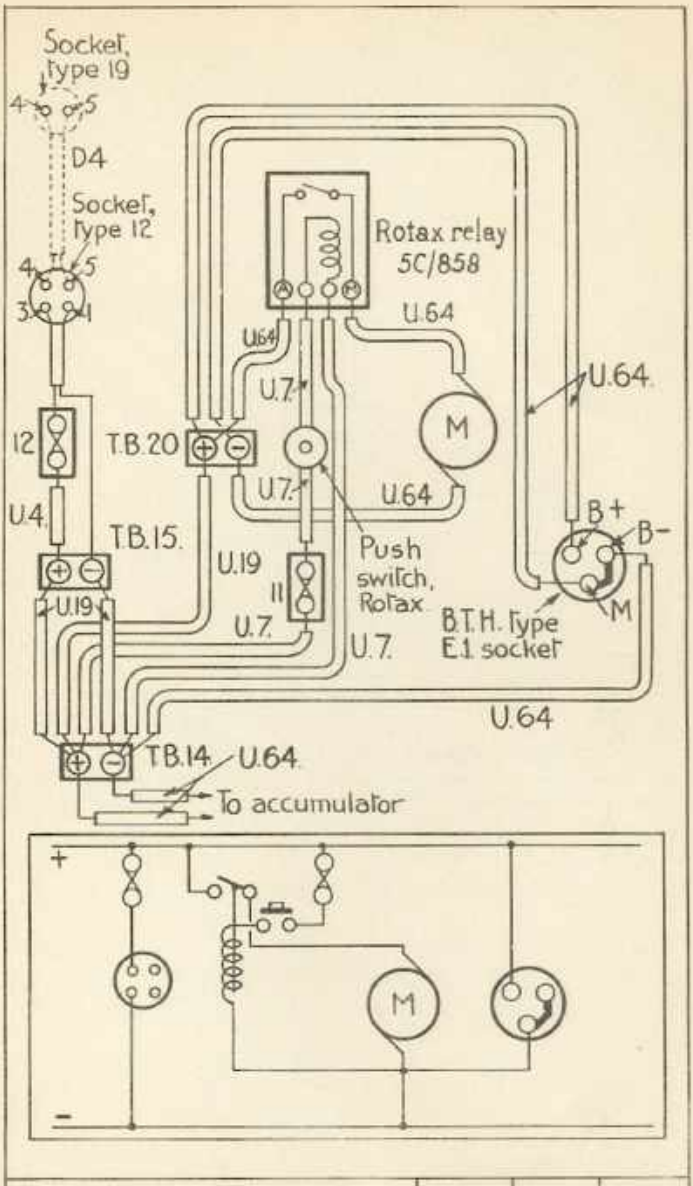


FIG 6	AP1564A	VOL I	IDENTIFICATION LAMPS AND FUEL GAUGES CIRCUITS
	SECT 5	CHAP 1	



ENGINE STARTING AND W/T SUPPLY CIRCUITS	A.P.1564A	VOL. I.	FIG. 7.
	SECT. 5	CHAP. 1.	

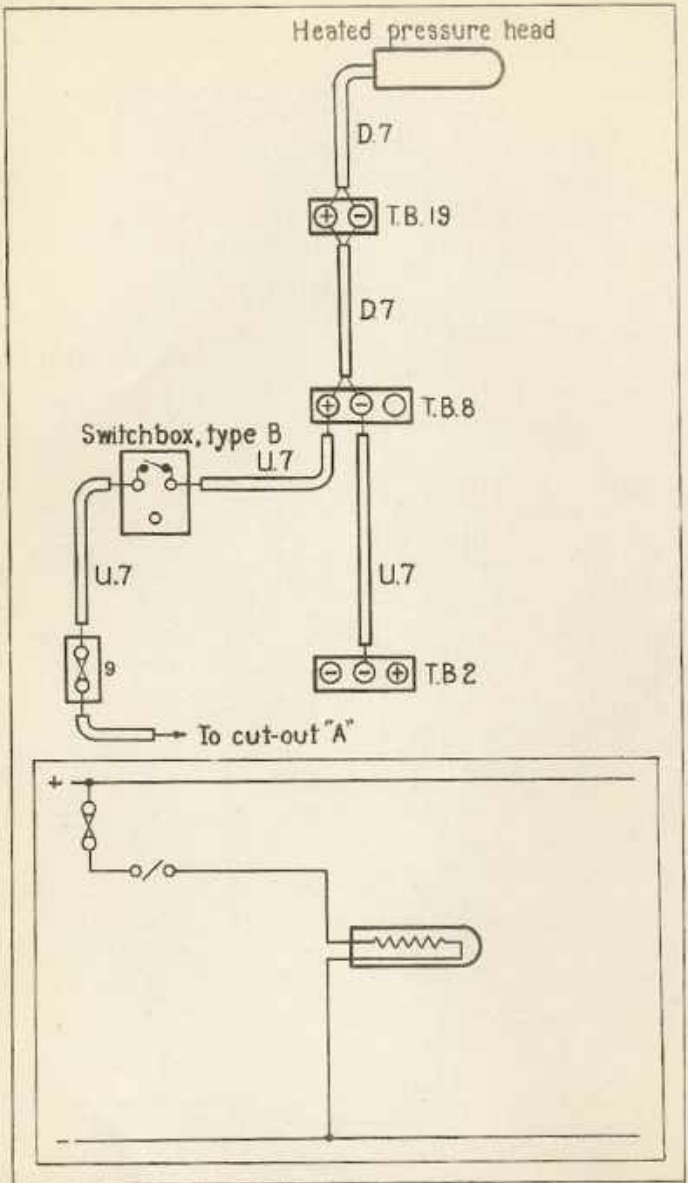
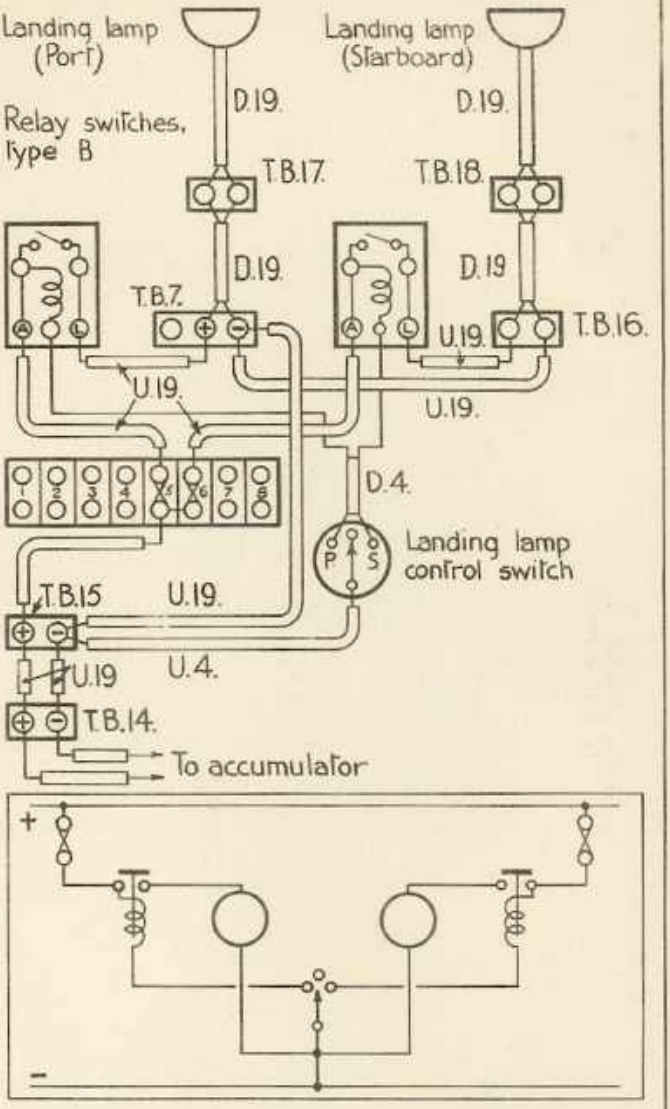


FIG.8	AP1564A	VOL.I	HEATED PRESSURE HEAD CIRCUIT
	SECT.5	CHAP.1	



LANDING LAMPS CIRCUIT	A.P.1564A	VOL. 1.	FIG. 9.
	SECT. 5.	CHAP. 1.	

F.S./8

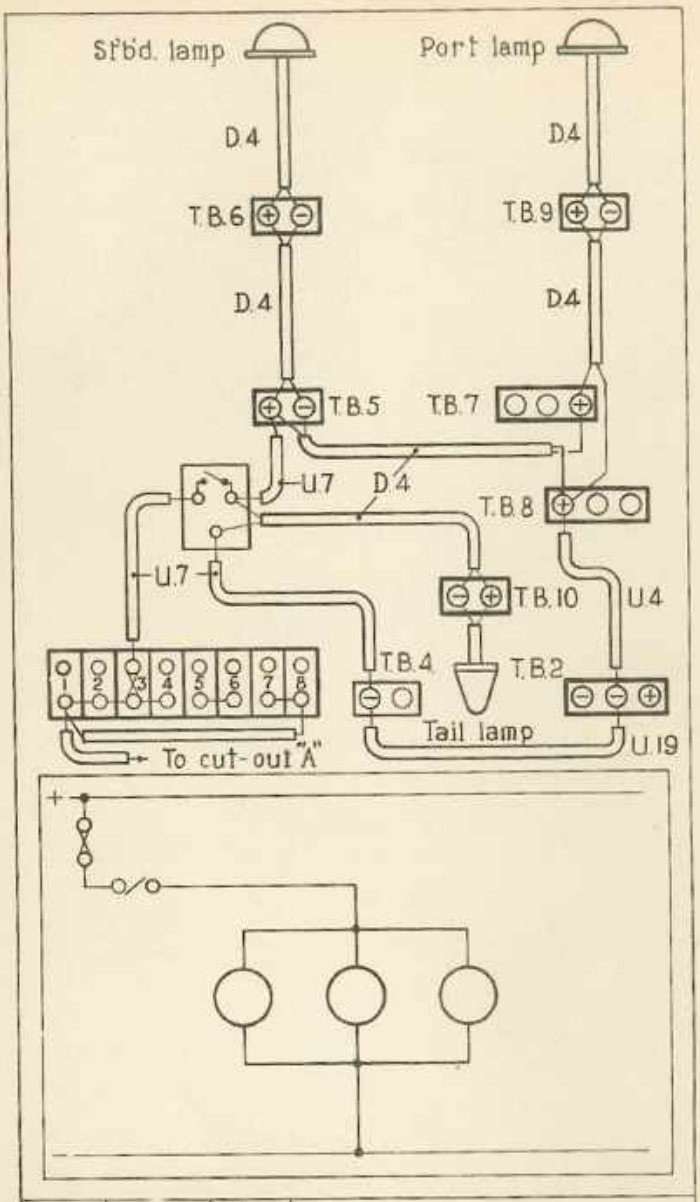
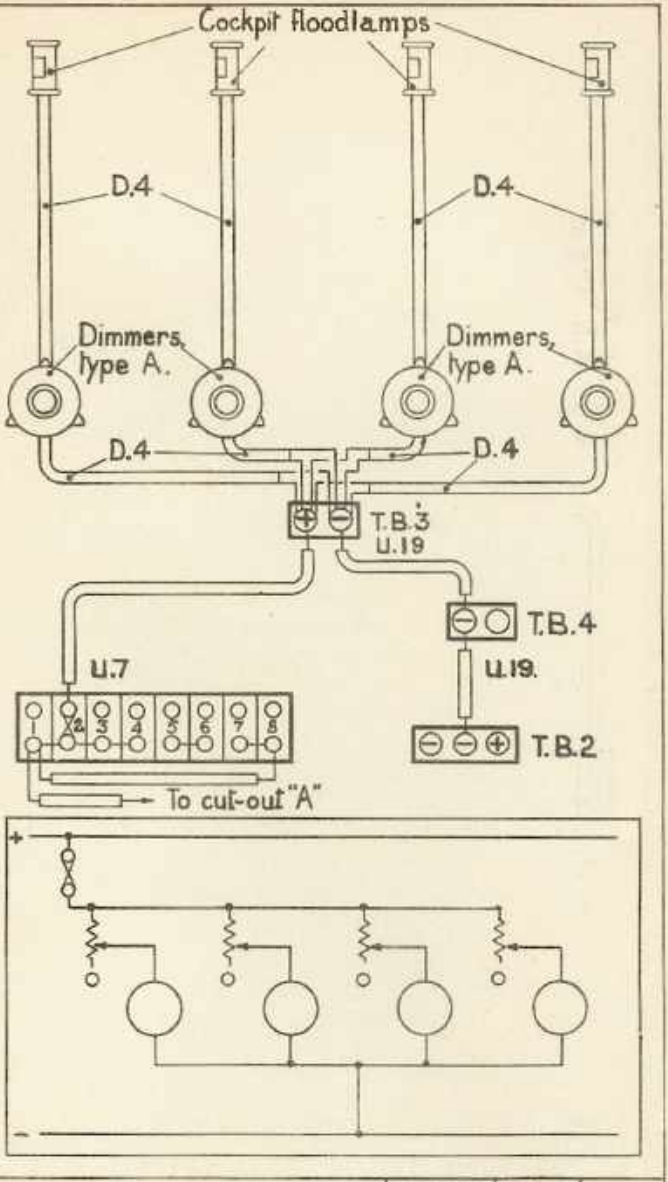


FIG.10	AP1564A	VOL.I	NAVIGATION LAMPS CIRCUIT
	SECT. 5	CHAP.1	



INSTRUMENT LIGHTING CIRCUIT	A.P. 1564A	VOL. I.	FIG. 11
	SECT. 5	CHAP. 1	

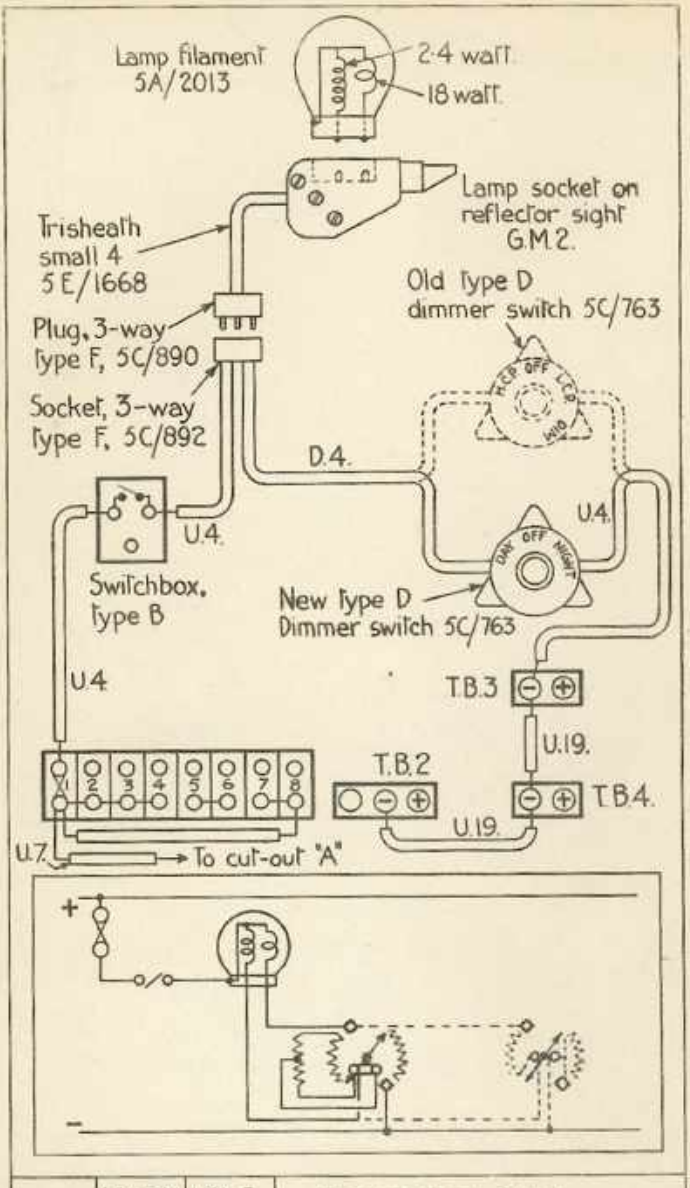


FIG.12.	A.P.1564A	VOL. I.	REFLECTOR GUN SIGHT CIRCUIT
	SECT. 5.	CHAP. 1.	

SECTION 7

ENGINE INSTALLATION

SECTION 7

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SECTION 7

ENGINE INSTALLATION

Engine

1. The aeroplane is powered with a Merlin II or III engine; for full particulars of the engine construction and methods of operation reference should be made to A.P.1590B, Vol.I. The engine is supercharged, and cooled by ethylene glycol, its twelve cylinders being ranged in two 6-cylinder mono-blocks set at 60° to one another. Reduction gearing is employed in the drive to the airscrew, which may be either a fixed-pitch wooden airscrew or a variable-pitch metal airscrew, provided with a two-pitch or constant-speed control. The exhaust manifolds in early aeroplanes were of kidney type, but later aeroplanes are fitted with ejector type exhaust manifolds as shown in the photographs in this volume. Boost pressure control is automatic but, in conditions of emergency, the automatic control may be cut-out to obtain maximum permissible boost pressure. The carburation system employs an automatic mixture control and an automatic two-stage enrichment device, the former worked by air intake pressure, and the latter by boost pressure; the enrichment device is provided as a safety measure to ensure that the mixture strength will be suitably enriched at large throttle openings. The ignition timing is interconnected with the manual throttle control lever.

2. An air compressor is driven from the rear end of the starboard camshaft whilst an engine-speed indicator is driven from the rear end of the port camshaft. An electrical generator is mounted on the port side of the crankcase and an electric starting motor is mounted vertically on the right-hand lower side of the wheelcase; a hand turning gear, with an operating handle on each side of the engine, is incorporated with the gear train for the electric starting motor. A dual gear-type fuel pump is driven in tandem from the left-hand side of the wheelcase whilst an oil pump for operating the hydraulic system is mounted at the base of the crankcase. On later aeroplanes the suction for the suction-operated instruments on the instrument-flying panel is obtained from a vacuum pump mounted on the lower face of the reduction gear casing. Gauges are fitted in the cockpit to show engine speed, boost pressure, oil pressure and temperature, coolant temperature and fuel pump pressure.

Fuel system

3. The fuel system (see fig.1 and the relevant illustration in Sect.2) is arranged so that the fuel is normally drawn by the dual engine-driven pumps in approximately equal quantities from

each main fuel tank in the centre section, a reserve tank being fitted in the fuselage immediately in front of the pilot's instrument panel; this latter tank also provides a supply for the engine primer pump. The supply from the main tanks or from the reserve tank is governed by a three-way cock remotely controlled from the cockpit; a fuel filter is fitted between the three-way cock and the engine.

4. Main tanks.- Each main fuel tank is of approximately rectangular form (see fig.2) and is constructed from sheet aluminium; four attachment feet are bolted to the tank shell. The top surface is strengthened by small swaged troughs which accommodate the eight specially-housed Simmonds nuts for the attachment of the upper aerofoil surface, seven similar nuts being also incorporated in the tank lower surface for the attachment of the lower aerofoil surface. Within the tank there are two longitudinal baffles and three transverse baffles, two tunnels being fitted between the inboard and outboard sides for the passage of the centre section inter-girder bracing tubes (see Sect.6, Chap.2).

5. The screwed filler cap, situated in the upper front outboard corner of the tank, is fitted with an internally-secured chain and is deeply slotted to facilitate its removal. Access to the filler cap is obtained through a door in the centre section upper tank cover and, to avoid loss, the door is attached internally to the door frame by a length of balloon cord. The outlet connection is situated in a recess in the inboard lower edge of the tank, the vent connection being in the front face near the upper edge of the tank and towards the inboard side. Two handholes are provided for inspection of the interior of the tank, one in the outboard face towards the rear, and one in the underside towards the front. A flush-type electrical fuel contents gauge (see A.P.1275, Vol.I) is situated in a recess in the centre of the upper rear edge of the tank.

6. Each main tank is housed between the centre section inner and outer girders (see Sect.6, Chap.2) and is carried by four brackets, two on each girder upper boom. Each of these brackets has an internally-tapped spigot over which a circular rubber pad is first placed to form the actual seating for the tank foot. The tank is then placed in position over the upper end of the spigot and another similar pad placed on the upper side of the tank foot; the pads are of such a thickness that the spigot does not project through the total thickness. A washer is placed on top of the uppermost pad and a bolt inserted in the spigot; the bolt is then screwed down to compress the pads until stopped by the end of the spigot.

7. Reserve tank.- The reserve fuel tank is of approximately semi-circular form (see fig.3) and is constructed from sheet aluminium; the tank is fitted internally with one longitudinal baffle in the centre of which there is a large approximately-rectangular flanged hole. A channel-section bearer, lightened with flanged holes, is fitted at each end across the bottom of the tank; the four tank feet are bolted externally to these cross bearers. The front tank feet are mounted on fuselage cross strut AA and the rear feet

on longerons AC, port and starboard. Each tank foot comprises an upper and a lower semi-circular portion which are hinged together, the front feet at their front ends and the rear feet at their outboard ends. When the tank is in position on the longerons and cross strut, the ends of the tank feet which are remote from the hinges are bolted together; rubber blocks are interposed between the feet and the tubes on which they are mounted in order to damp vibration.

8. The screwed filler cap, situated in the top of the tank near the front end and slightly to starboard, is fitted with an internal retaining chain and has a deep slot to facilitate turning. Access to the cap is obtained through the upper and rearmost of the two doors in the top rear panel of the engine cowling; to avoid loss, the door is attached internally to one of the fastener springs with a length of balloon cord. The sump, embodying the outlet connection and draining connection, is in the underside of the tank slightly to the front, whilst the vent pipe connection is also in the underside near the centre of the port side edge. A priming pipe connection is situated in the rear face of the tank near the top and a flush-type electrical fuel contents gauge (see A.P.1275, Vol.I) is situated in a pocket in the upper rear edge of the tank, slightly to starboard.

9. Fuel contents gauges.- The electrical fuel contents gauge fitted to each fuel tank is of the float and potentiometer type; a selector switch, in conjunction with a meter, both fitted on the starboard side of the instrument panel, enables the contents of any tank to be determined at will. A wiring diagram for the fuel contents gauges is illustrated in Sect.5.

10. Pipe-lines.- A two-way cock is fitted at each tank outlet connection, the cocks being normally locked in the "open" position except in such special circumstances as when about to remove a tank. The two main tanks are interconnected through a T-piece with a non-return valve on each side, the valves being fitted to prevent any flow from one tank to the other whatever the attitude of the aeroplane. From the third arm of the T-piece, a pipe is taken to the three-way fuel cock which is mounted on the port lower longeron just aft of joint B. The supply pipe from the reserve tank is lead to the opposite connection on the cock, the cock being remotely-controlled by a handle mounted on the port side of the fuselage, in the angle between struts CF and CF1. From the three-way cock, a flexible pipe runs to the rear face of the centre section front spar web where it is coupled to the inlet connection of a filter; the filter is mounted on the front face of the spar, the connection projecting through the spar web.

11. At the top of the filter is the outlet branch which is connected by a coupler to a T-piece. In early aeroplanes, a non-return valve is screwed into one branch of the T-piece and, from the non-return valve, a flexible pipe runs directly to another T-piece connected by a coupler to the carburettor. In later aeroplanes,

the non-return valve and this latter pipe are not fitted, one branch of each T-piece being blanked off. From the other branch of the T-piece on the filter, a flexible pipe runs to the inlet connection of the engine fuel pump and, from the outlet connection of the fuel pump, another flexible pipe runs to the remaining branch of the T-piece on the carburettor; in later aeroplanes, this latter pipe-line includes a pressure-reducing valve from which a balance pipe is taken to the engine air intake. In early aeroplanes, the flexible pipe from the T-piece on the filter to the T-piece on the carburettor, permits a flow under gravity from the reserve tank to the carburettor whilst the non-return valve fitted to the filter outlet prevents the possibility of the pump feeding fuel back into the reserve tank when the engine is running. As the capacity of each fuel pump is in excess of the maximum demands of the engine, a suitable relief valve is fitted in the dual pump unit.

12. From a banjo fitting at the priming connection on the reserve tank, a supply pipe runs to the inlet connection of the manually-operated primer pump which is mounted on a bracket on fuselage joint C on the starboard side. The priming delivery pipe runs directly from the pump to the engine primer connection, from which it is distributed by four pipes to the induction manifolds. The vent pipes of all three fuel tanks meet at a fitting on the reserve tank vent pipe connection, whence a common vent pipe runs aft and connects with a pipe projecting from the rear of the radiator.

13. A fuel pressure gauge, mounted on the starboard side of the instrument panel in the cockpit, is connected by a capillary tube, in early aeroplanes to the delivery side of the engine pump and, in later aeroplanes, to the pressure-reducing valve on the engine. From a connection on the engine induction manifold, a small-diameter tube runs to a fuel trap mounted on the port side of the front face of the fireproof bulkhead, whence a similar tube continues to a boost pressure gauge on the starboard side of the instrument panel in the cockpit. All joints in the fuel system are standard unions locked with wire, except in the case of the vent pipes where all the connections are of rubber hose secured by jubilee clips bonded with copper strips.

Oil system

14. The lubrication system of the engine is of the conventional dry sump type necessitating the use of an external oil tank, the engine pumps maintaining the oil in constant circulation from the tank, through the engine and back to the tank; an oil cooler, a viscosity valve and an oil filter are also included in the circuit. The oil tank forms part of the port leading edge of the centre section (See Sect.6, Chap.2, fig.2) and is attached to the front spar by means of two pairs of feet situated along the upper and lower rear edges of the tank; insulation against vibration is similar to that used with the main fuel tanks in the centre section. At the top and bottom, the tank skin projects rearwards beyond the rear tank wall; the upper edge meets the forward edge of the outer cover over the port main fuel tank and is screwed to the cover,

whilst the lower edge engages with a fairing strip beneath the spar. The flanges of the inner and outer end walls of the tank project sufficiently beyond the tank skin to provide seatings for the leading edge fillet and the gap fairing between the centre section and the port outer plane. The tank when filled contains 7½ gallons of oil, leaving 3 gallons air space. An oil cooler of increased cooling area and a differently-graduated viscosity valve are fitted when the aeroplane is equipped for tropical use.

15. Oil tank.- The tank (see fig.5) is constructed from duralumin sheet to the profile of the centre section leading edge at its point of attachment. Two baffles are fitted within the tank parallel to the centre line of the aeroplane. The outboard baffle has seven flanged holes approximately evenly spaced; the inboard baffle has two oval-shaped holes, placed approximately one-third of the depth of the tank from the top, and is drilled along the bottom edge with thirteen holes of small diameter. The enclosed portion between the inboard baffle and the inboard end of the tank acts when necessary as a partial-circulation chamber for quick warming of the oil and is of approximately 1½ gallons capacity.

16. The filler neck, situated centrally in the inboard wall, is fitted with a screwed cap which is retained against loss by a short length of chain attached to an internal C-spring; on early aeroplanes, the filler cap has a deep slot to facilitate its fitting and removal but, in later aeroplanes, a lugged filler cap is provided. Access to the filler cap is obtained through a door in the port leading edge fillet between the centre section and the fuselage; the door is attached with four fasteners and, as a precaution against its loss, it is secured internally with a length of balloon cord. The oil inlet and outlet connections are situated in the inboard wall of the tank, the former at the top; internally, the inlet connection is extended forward by a short tube with a flared end, whilst the outlet connection is continued by a plain tube pointing downwards. The oil inlet connection is incorporated with the filler neck in an oval-shaped plate which may be removed for cleaning and inspection of the interior of the tank; for the same purpose, a circular handhole is provided in the outboard wall. The vent pipe connection is near the top of the rear wall about half-way along the length of the tank, and below it, in the bottom rear edge of the tank, a drainage connection is fitted; the drainage connection incorporates a screw cock.

17. Oil cooler.- This cooler is of box form, and is housed between the two halves of the coolant radiator; the top is constructed of sheet brass whilst the bottom portion, comprising longitudinal sides and base, is constructed of cupro-nickel. Baffles (also of cupro-nickel) are so arranged as to divide the cooler into two longitudinal chambers and to sub-divide each chamber into three tiered galleries. Ports in the alternate ends of the horizontal baffles provide means of inter-gallery communication, inter-chamber communicating ports being provided at the front end of the longitudinal vertical baffle in the bottom gallery.

18. The oil inlet and outlet branches are mounted at the top of the cooler, the inlet branch communicating with the starboard and the outlet branch communicating with the port longitudinal chamber. In each gallery is housed a bank of honeycomb radiator tubes around which the oil flows, the inlet oil flowing forward along the starboard top gallery, aft along the centre gallery and then forward again along the starboard bottom gallery. At the forward end of the starboard bottom gallery, the oil passes into the port bottom gallery from which, in a reverse sequence of flow direction, it is led to the oil outlet at the rear of the port top gallery. A drain plug, with its mounting communicating with both port and starboard bottom galleries, projects through the inter-communicating channel at the bottom of the coolant radiator (see para.35).

19. Viscosity valve.- This valve (see fig.6) comprises a cylindrical casting (M) in which are three chambers (H), (L) and (E), the chamber (E) being provided with inlet and outlet branches, the chamber (L) with an inlet branch, and the chamber (H) with an outlet branch. Between chambers (L) and (E) is a spring-loaded by-pass valve, and between chambers (L) and (H) is a valve of complex design, the operation of which is entirely dependent on the degree of viscosity of the circulating oil.

20. Oil from the engine enters the chamber (H) and according to its degree of viscosity passes through the appropriate valve either into the chamber (E) and thence to the oil tank, or into the chamber (L) and thence to the oil cooler. The oil from the cooler passes directly through the chamber (E) back to the oil tank.

21. A portion of the oil from the engine passes from chamber (H) through a small filter (G) and thence through a small orifice in the plate (J) into the interior of the bellows (C). The oil then passes through a number of small-bore passages (N) into the annular space in the end of the valve, whence it passes through the communicating passage (F) into the chamber (E) (which is approximately at atmospheric pressure) and thence to the oil tank.

22. When the oil is cold and/or viscid, it passes through the orifice in the plate (J) but does not readily pass through the small-bore passages (N), thereby automatically setting up a pressure within the bellows. When this pressure, in conjunction with that exerted by the spring (B), exceeds the pressure exerted by the spring (D), the by-pass valve (A) is lifted from its seating and the oil is by-passed to the tank without passing through the cooler.

23. When the oil has dropped below the required degree of viscosity, the free flow through the small-bore passages prevents the building up of any pressure within the bellows, with the result that the valve (K) is lifted from its seating and the oil flows into chamber (L) and thence to the oil cooler. From the cooler, the oil passes into one side of chamber (E) and out through the other side to the oil tank.

24. Due to the changes of viscosity being necessarily gradual, the action of the valve (K) is gradual. The load of the spring (B) is regulated and set so that the oil from the engine is automatically

by-passed to the tank or directed through the cooler. Should failure occur of any part of valve (K), oil is automatically directed through the cooler.

25. Oil filter.- This filter (see fig.7) is mounted on the front face and to the starboard side of the fireproof bulkhead. The cylindrical filter body has an upper branch for the inlet and a lower branch for the outlet connections, a drain plug being incorporated at its lower end; two locating shoulders are provided to receive the securing cap. A gauze-covered filter element is retained within the body by a retaining spring, a sealing cap and a securing cap fitted with an adjusting screw.

26. Pipe-lines.- The oil system installation is shown in fig.4 and a diagrammatic arrangement is given in Sect.3. From the outlet connection on the inboard wall of the tank, a pipe is taken through a gland in a small bulkhead fitted in the port leading edge fillet to the upper inlet connection of the oil filter, mounted on the front face of the fireproof bulkhead on the starboard side; from the lower connection on the filter a flexible pipe runs to the inlet connection of the engine oil pump. From the engine outlet connection, a small flexible pipe connects with a pipe leading to a double-ended union fitted in the fireproof bulkhead on the port side just above the centre section spar. From the rear face of the fireproof bulkhead, a pipe is taken along the port side of the fuselage to the viscosity valve mounted on fuselage strut PH1; the pipe is supported on fuselage side struts AD and CF.

27. When the oil is of high viscosity, the viscosity valve by-passes the oil back to the oil tank thus short-circuiting the oil cooler; the oil cooler is incorporated in the centre of the radiator beneath the fuselage and is connected to the viscosity valve by two short pipes. When the oil has reached a suitable viscosity, the valve causes the oil to flow through the oil cooler before returning to the oil tank. From the viscosity valve, the oil is returned to the oil tank through two lengths of pipe joined together by a union fitted in the fireproof bulkhead. From the viscosity valve to the bulkhead, the return pipe is carried in the same support brackets as the delivery pipe; the return pipe from the front face of the fireproof bulkhead is joined, through a gland in the port leading-edge bulkhead, to the inlet connection of the oil tank.

28. From the vent connection in the upper edge of the oil tank, a vent pipe is taken through a gland in the port leading-edge bulkhead and continues along the front side of the centre section front spar to the crankcase breather on the starboard side of the engine. The vent pipe is in four sections joined by means of rubber hose connections secured with jubilee clips; a T-piece is incorporated between the two sections nearest the engine to provide a connection for the vacuum pump installation (see Sect.10). The oil pressure gauge on the starboard side of the instrument panel is joined by a capillary tube to a banjo fitting on the engine,

whilst a similar tube connects the thermometer bottle on the engine with the oil temperature gauge, situated on the instrument panel beneath the oil pressure gauge.

Cooling system

29. The engine is cooled with ethylene glycol which is passed around the cooling system (see fig.8) by means of a centrifugal pump driven from the base of the engine wheelcase. From the engine, the coolant is passed through two outlets to the header tank mounted on the front face of the fireproof bulkhead, and thence aft to the radiator situated beneath the fuselage, whence it is passed forward to the single inlet connection on the engine pump. The cooling system incorporates a thermostat which by-passes the radiator when the coolant temperature is low. The quantity of cooling air passing through the radiator may be controlled from the cockpit by a flap fitted to the radiator fairing. For tropical use, a radiator with increased cooling area is fitted.

30. Header tank.- This tank, constructed from sheet brass to the shape shown in fig.9, is carried on two brackets on the front face of the fireproof bulkhead with a single bolt through each of the four tank feet. Rubber packings are interposed between the tank feet and the brackets, and between the brackets and the bolt heads to provide insulation against vibration.

31. Two baffles are fitted across the tank in line with the centre line of the aeroplane and extend from the bottom of the tank up to the normal level of the coolant; the baffles are provided with six flanged holes of varying diameter. The heated coolant from the engine is passed into the tank through two inlet connections riveted through flanged spools into the front face of the tank; the conical sump is bolted into the bottom surface of the tank and itself provides the outlet connection. The pipes forming the inlet connections are continued internally to the centre of the tank where they are bent to run upwards towards the top; near the top they are bent outwards and their upper sides riveted to the top surface. A slightly smaller-sectioned pipe is brazed into each inlet pipe where it is bent upwards, the smaller pipes projecting downwards into the top of the tank sump.

32. The tank is normally only filled to half its total volume, i.e. 4 gallons. When the coolant is cold it flows through the smaller-sectioned pipes into the sump and out through the connection at the bottom, thus mixing with the minimum of cold coolant and providing rapid warming-up of the engine; under cruising conditions, the same direction of flow obtains. Under high-power running, the rate of flow is increased and a certain amount of steam is generated; in consequence, the steam (and some of the coolant) passes up the vertical pipes and is sprayed from their upper ends into the colder coolant on the outer sides of the baffles. Thus the steam is separated from the liquid coolant and condensed by the colder coolant outside the baffles; the hot

coolant which has passed up the pipes is thereby mixed with the colder coolant and, draining through the holes in the baffles, passes into the sump and out at the outlet connection.

33. The filler neck, fitted with a screwed filler cap and retaining chain, is situated in the starboard side of the tank; access to the filler cap is obtained through the forward and lower of the two doors in the top rear cowling panel on the starboard side. A vent pipe, connected into the tank through a relief valve situated approximately in the centre of the upper surface of the tank, is taken down the inside of the engine cowling on the starboard side to vent directly to the atmosphere through a rubber connection in the top front corner of the starboard intermediate side panel of the engine cowling. In the front face of the tank and between the two connections for the return pipes from the engine, a connection for a thermometer bottle is riveted to the tank, a capillary tube being taken from the bottle to the meter on the starboard side of the instrument panel.

34. Radiator.- The combined coolant radiator and oil cooler (see fig.8) is suspended beneath the fuselage just aft of the centre section rear spar; at the front it is bolted to brackets on the rear face of the rear spar lower boom and at the rear to brackets on the radiator support tubes which are fitted between fuselage joints H and the lower boom of the centre section rear spar. To protect the radiator from excessive vibration, thick rubber liners are inserted in the attachment bolt housings; the housings are bolted to the attachment brackets which are riveted to the radiator shell at each end of each outboard side. The oil cooler is accommodated between the two halves of the radiator honeycomb, being held in position by two channels on the upper surface which are bolted to small channels on each half of the radiator.

35. The coolant enters the radiator through a cone-shaped inlet branch fitted to the top surface of the upper half-honeycomb; the inlet branch is fitted internally with two vanes to spread the flow of the coolant. After passing down through the upper half-honeycomb, the coolant is taken across the bottom of the radiator beneath the oil cooler and continues up through the starboard half-honeycomb to the outlet connection; the outlet connection is of similar construction to the inlet connection, less the flow vanes. A baffle is fitted across each half-honeycomb in line with the centre line of the aeroplane and immediately beneath the centre line of the inlet and outlet branches. A drain plug is fitted into the undersurface of the radiator beneath the oil cooler, just in front of the drain plug for the oil cooler.

36. Radiator flap control.- The radiator is enclosed in a tunnel-type fairing beneath the fuselage, the quantity of air passing through the radiator being controlled by a flap, hinged along its front edge, which forms the rear part of the fairing undersurface. The flap is operated by two rods (see fig.10),

the upper ends of which are adjustable and attached to levers mounted on each end of a countershaft. The countershaft is supported at each end by a bearing, just inboard of the levers, secured to the lower longeron FH, port and starboard; at its port end, the countershaft carries another lever, the upper end of which is connected by a tube of fixed length to the lower end of the control hand lever mounted in the cockpit. The control hand lever is mounted on the port side of the pilot's seat between quadrant plates bracketed to fuselage cross strut FC.FC and is supported by a stay tube from port joint F. The hand lever may be set in any one of nine positions by depressing a knob at the top of the handle, moving the handle to the required position and releasing the knob; the knob is spring-loaded internally and operates a catch pin engaging with the notches in the quadrant plates.

37. Just inboard of the port bearing, the countershaft carries a small lever, the upper end of which is connected through a bowden cable with a flap position indicator mounted on port strut CF1; the indicator is calibrated to show "degrees of flap movement"

38. Pipe-lines.- The outlet pipe from the header tank sump (see fig.8) runs to starboard and then down almost to the bottom of the fireproof bulkhead, where it is joined to another length of pipe which passes rearwards through a gland in the bulkhead; the pipe continues along the starboard side of the fuselage beneath the plane-to-fuselage fairing fillet and is clipped to fuselage side strut CF. Just aft of joint F, the pipe is joined to a short length of pipe the aft end of which is coupled to the thermostat bracketed to fuselage side strut FC.H. Two pipes run from the thermostat, one continuing aft and then forwards to the starboard inlet branch to the radiator and the other passing across the fuselage to the return pipe from the radiator. The former pipe is in two parts coupled together at its aft extremity and is clipped to fuselage cross strut HH between the coupling and the radiator, whilst the latter pipe is coupled to a T-joint in the return pipe from the radiator.

39. From the port branch connection on the radiator, the return pipe-line is taken along the centre line of the aeroplane, through a gland in the web of the centre section rear spar, to a clip on fuselage cross strut DD and then to port through a gland in the web of the centre section front spar. A separate length of pipe is used between the spars and through the front spar, the joints in the pipe-line being adjacent to each spar; a vent plug is fitted between the clip on fuselage cross strut DD and the front joint. From the joint just in front of the centre section front spar, a short length of pipe connects directly with the centrifugal pump on the engine. After the coolant has been pumped around the engine, it is returned through two parallel pipes into the front face of the header tank. All pipe connections in the cooling system are made by rubber hose secured with jubilee clips, each connection being electrically bonded.

Thermostat

40. The thermostat serves to decrease the time taken in warming-up the engine by returning the coolant through the by-pass directly back to the engine until such time as the coolant has reached a temperature necessitating the use of the radiator; it also prevents cavitation in the engine pump due to increased flow resistance of the radiator when the coolant is cold.

Ignition system

41. The diagram of the ignition system (see fig.11) shows the connections between the main magnetos, the starting magneto and the control switches; for the operation of the system and the connections between the magnetos and the distributors, reference should be made to A.P.1590B, Vol.I. The starting magneto is mounted on the starboard engine mounting strut XZ.

Engine controls

42. Throttle and mixture controls.- These engine controls (see fig.12) are mounted on the port top longeron CE, close to the pilot's left hand. The longer (inboard) lever is the throttle control and the shorter the mixture control; the levers are moved forward to "open" the throttle and to weaken the mixture. The knob on the mixture control lever projects in the way of the throttle control lever to ensure that the mixture control is pulled back to RICH on closing the throttle, thus preventing the mixture from being excessively weakened at small throttle openings.

43. The two levers are mounted outboard of the longeron on concentric spindles, and are retained in any required position by tightening a series of friction discs mounted on the outer spindle. The spindles project inboard below the longeron, the inner being fitted with a knurled cap whilst the outer carries a small wheel just behind the knurled cap. By turning the knurled cap, the friction on the mixture control lever may be adjusted, the wheel providing a similar adjustment for the throttle control lever.

44. Below the spindles, a small box contains a micro-switch unit for the undercarriage warning buzzer, the switch being operated by a cam plate pivoting about a pin at the lower rear corner of the box; this cam plate is actuated by a roller mounted on the bolt attaching the throttle control rod fork-end to the throttle lever.

45. The two control levers project upward through a plate mounted on the decking shelf; adjustable stops are fitted at the forward ends of the paths of travel of the levers. Pinned to the lower end of each control lever is a fork-end into which is screwed the end of a flexible push-pull member operating in a conduit; the conduit runs forward and downwards along the port side of the fuselage structure, passes through a gland in the fireproof bulkhead and is

then anchored to a bracket on the front face of the fireproof bulkhead. A rod, attached to the flexible member, emerges from the conduit at its anchorage and is connected to its appropriate lever on the engine by means of a fork-end and pin.

46. Automatic boost control.- An automatic boost control is provided to maintain a constant boost pressure without continual manipulation of the throttle control. In conditions of emergency, the boost control cut-out may be used to render the automatic boost control virtually inoperative, thus enabling the throttle to be fully opened by the cockpit control lever at any altitude; the cut-out control is located on the port side of the instrument panel. A boost gauge, connected with the induction manifold, is mounted on the starboard side of the instrument panel.

Airscrew controls

47. Two-pitch control.- The control lever is fitted on the port side of the decking just above the throttle and mixture controls, Teleflex conduit and cable being used between the lever and the relief valve unit incorporated on the starboard side of the engine crankcase. From the lever, the conduit runs downwards and forwards through a gland in the fireproof bulkhead, across to starboard and then forward to terminate in a swivel end on engine mounting strut AZ.

48. Constant-speed control.- The control system is similar to that used for the two-pitch airscrew (see para.47) as far as the front face of the fireproof bulkhead. From the bulkhead, the conduit is carried forward along the port side of the engine to the governor unit on the underside of the engine nosepiece, the connection being made by means of a 180° - wrap box unit.

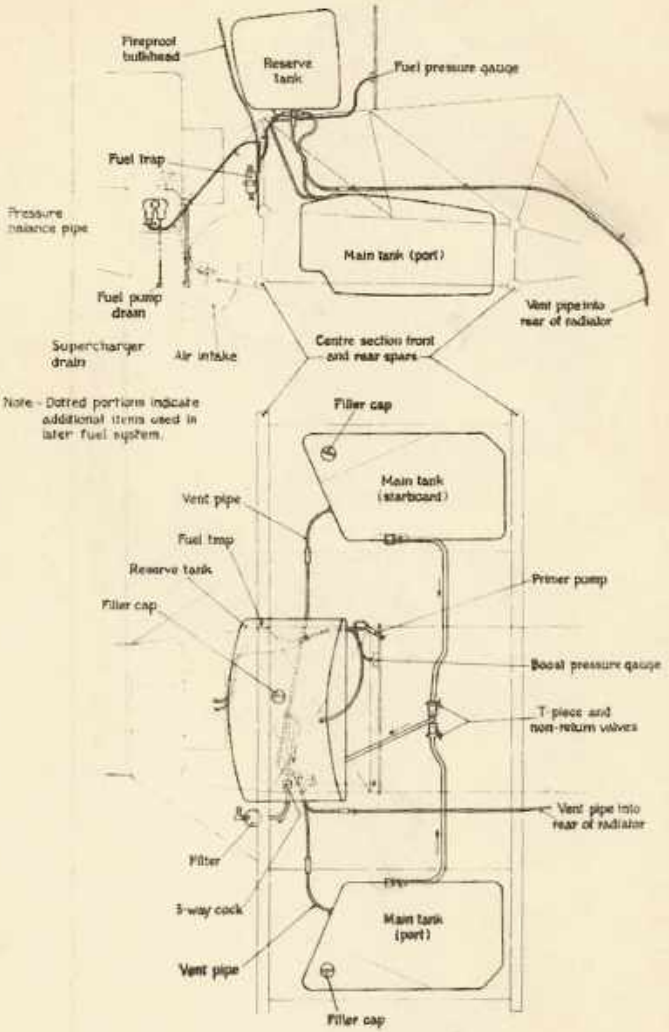
Hand starting equipment

49. Two starting handles are stowed in the wheel recess beneath the centre section (see Sect.6, Chap.1, fig.13), one on each side wall. In use, the handles are engaged with the ends of a countershaft carried in brackets on the engine mounting struts XZ. A sprocket at the starboard end of the countershaft is connected, by means of a chain, with a sprocket on the inboard end of a small countershaft mounted on the starboard engine mounting strut XY. The outboard end of this latter countershaft carries a double sprocket connected, by means of further chains, to the starter sprocket on the engine and to the starting magneto.

Electrical starting equipment

50. The wiring diagram for the electrical starting system is given in Sect.5, fig.7, the power for the system being supplied by the accumulator in the aeroplane except when an external supply is available. The external supply plug is connected with a socket in the aeroplane in which is combined an isolating switch for

automatically cutting out the aeroplane accumulator; the cover over the sockets must be rotated before the plug can be inserted, the rotation operating a switch which isolates the negative pole of the aeroplane accumulator. The combined socket and isolating switch is situated on the starboard lower strut of the engine mounting, and is accessible through a door in the engine cowling (see fig.13); a hook is provided on the door for the attachment of the lanyard of the ground cable. When the power supply has been connected, the engine may be turned by depressing a pressbutton switch, situated on the port side of the instrument panel; this switch operates a relay switch, mounted adjacent to the external supply socket, which in turn operates an electrical starting motor mounted on the starboard side of the engine wheel case.

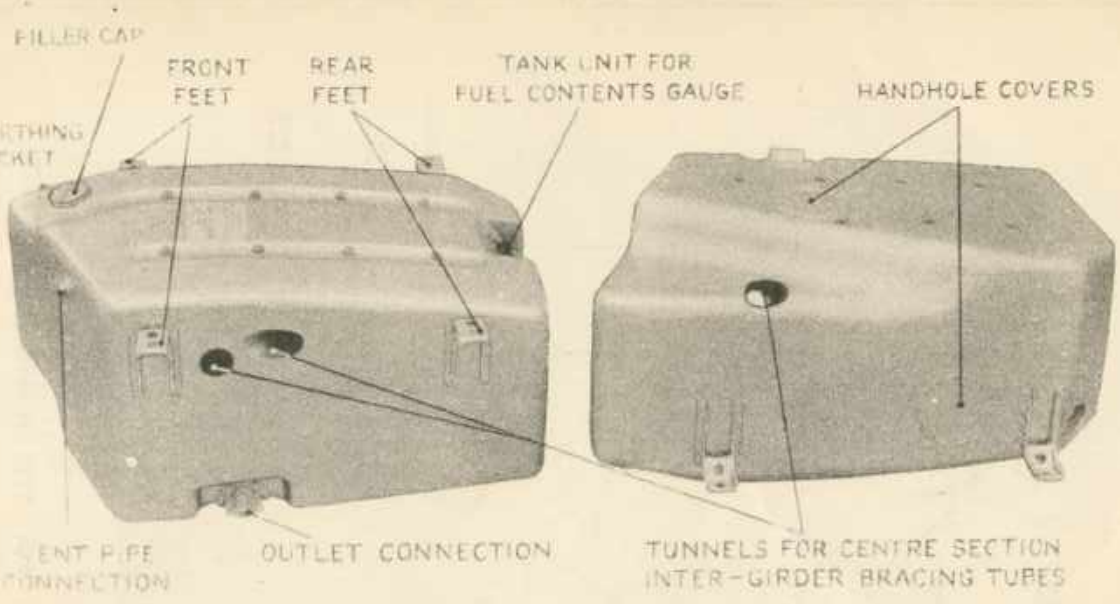


FUEL SYSTEM INSTALLATION

FIG.1

F.T./10

FIG.1



MAIN FUEL TANK (STARBOARD).

FIG.2.

FIG.3.

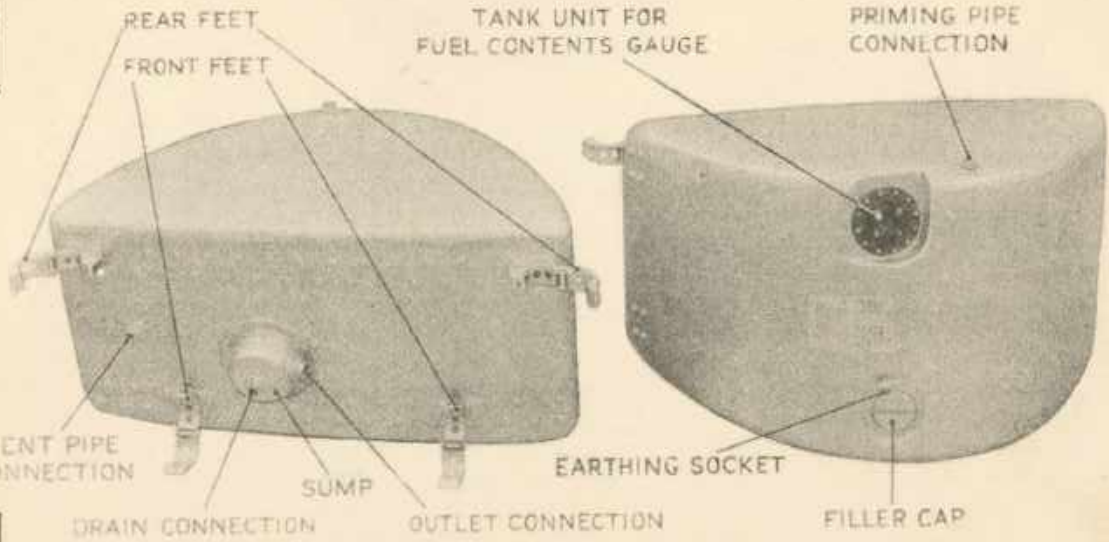
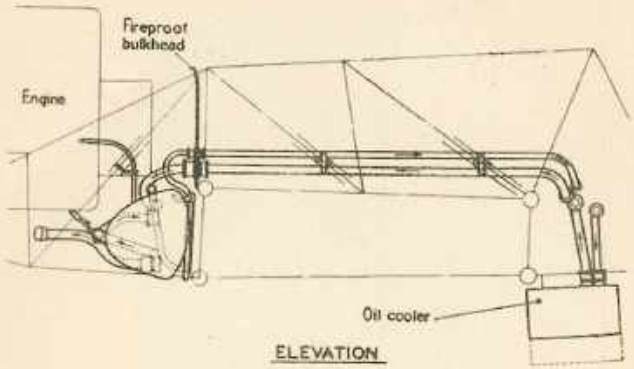


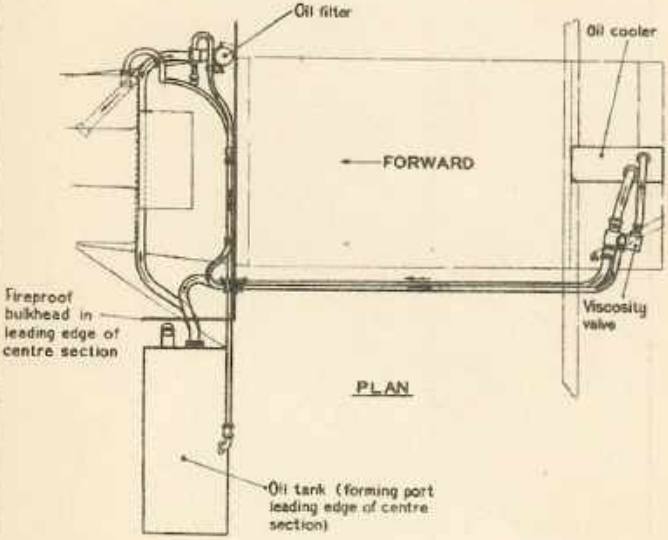
FIG.3.

RESERVE FUEL TANK.

F.S./11.



ELEVATION

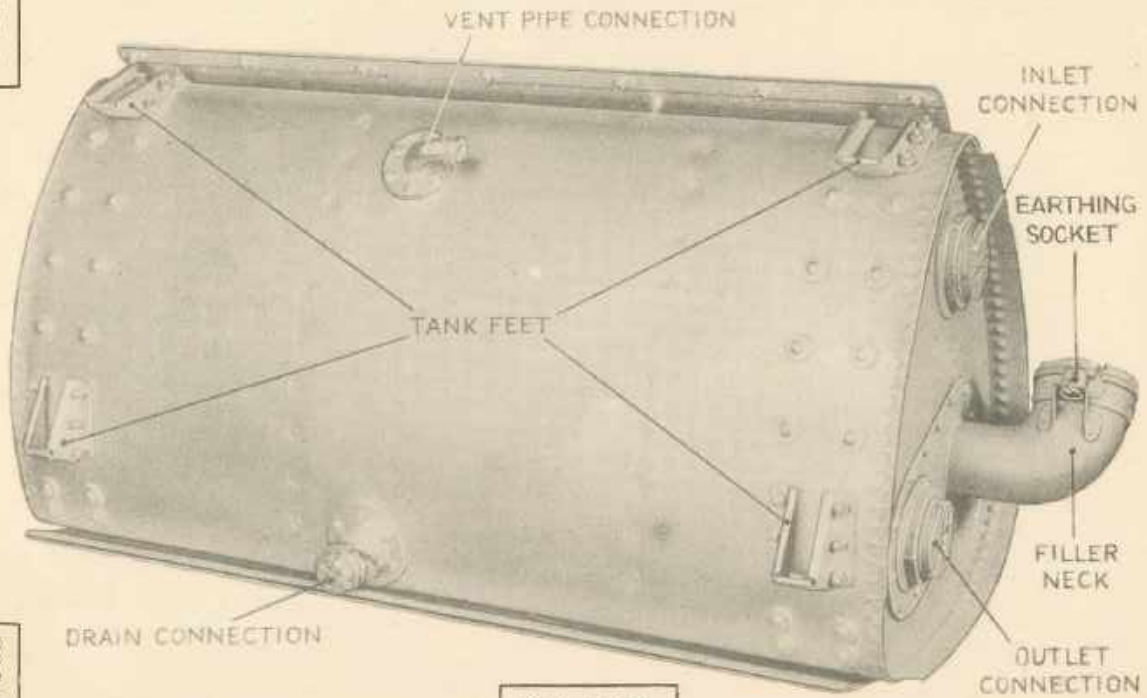


PLAN

OIL SYSTEM INSTALLATION

FIG. 4

FIG. 4



OIL TANK.

FIG.5.

FIG. 6

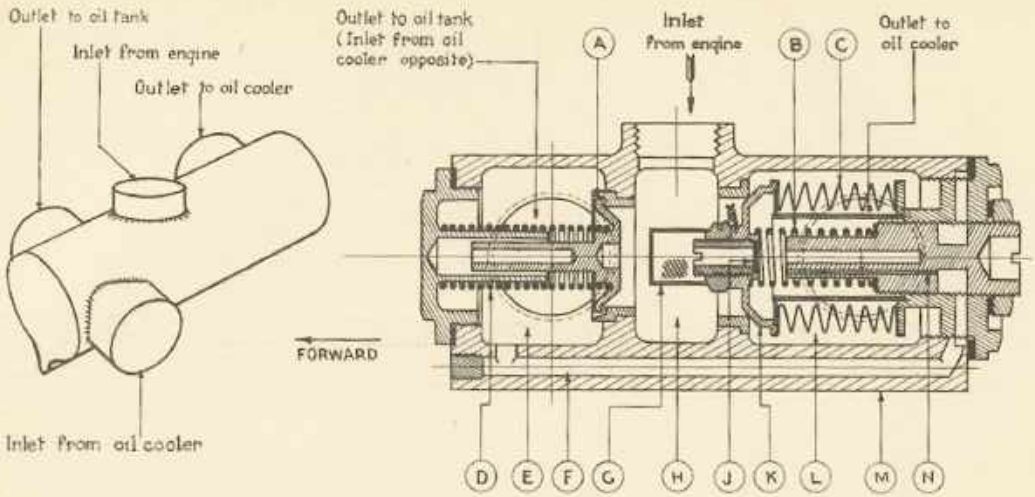
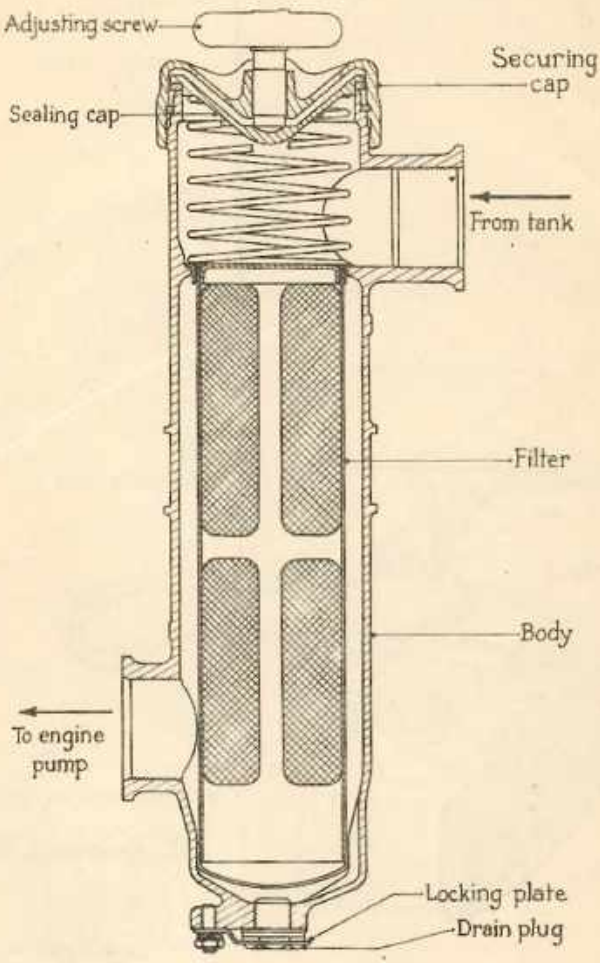


FIG. 6

VISCOSITY VALVE



OIL FILTER

FIG.7

FIG.7

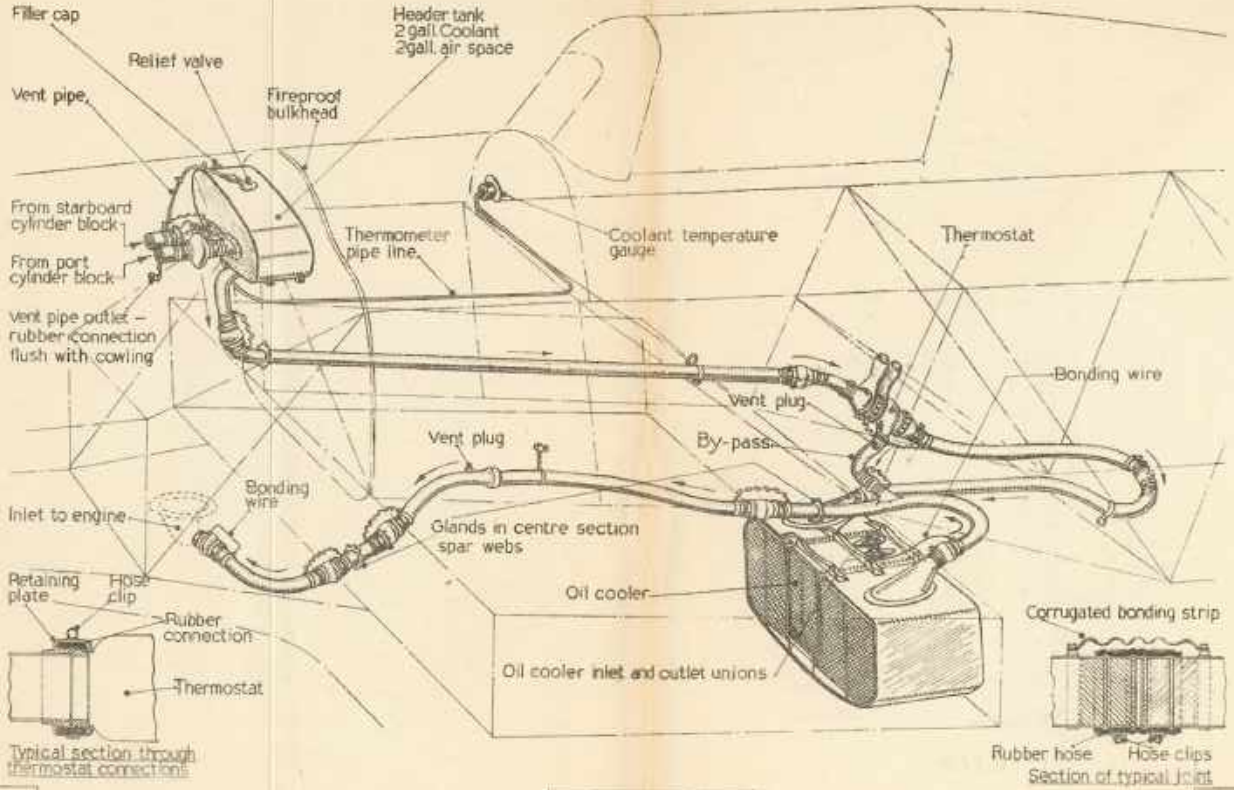


FIG. 8

COOLING SYSTEM

FIG. 8

FIG.9.

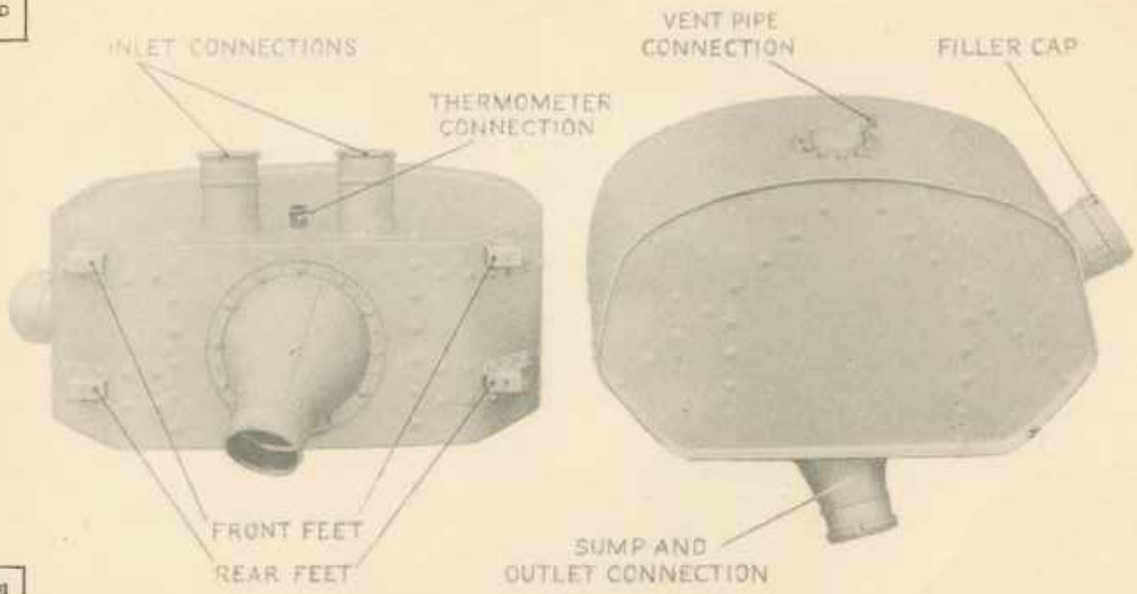


FIG. 9.

HEADER TANK.

FIG. 10

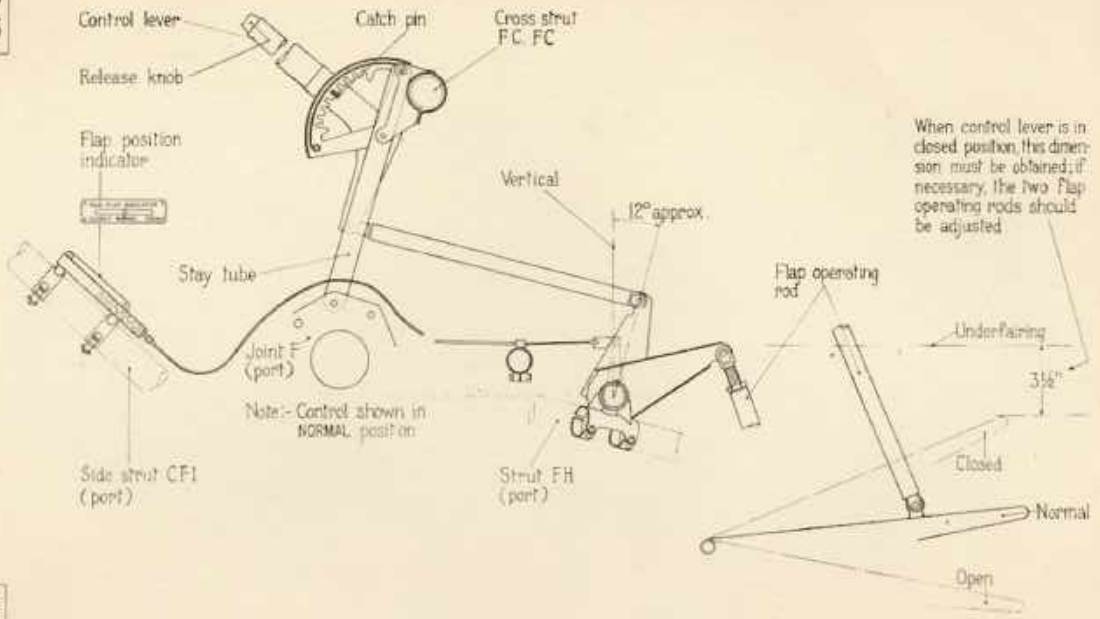
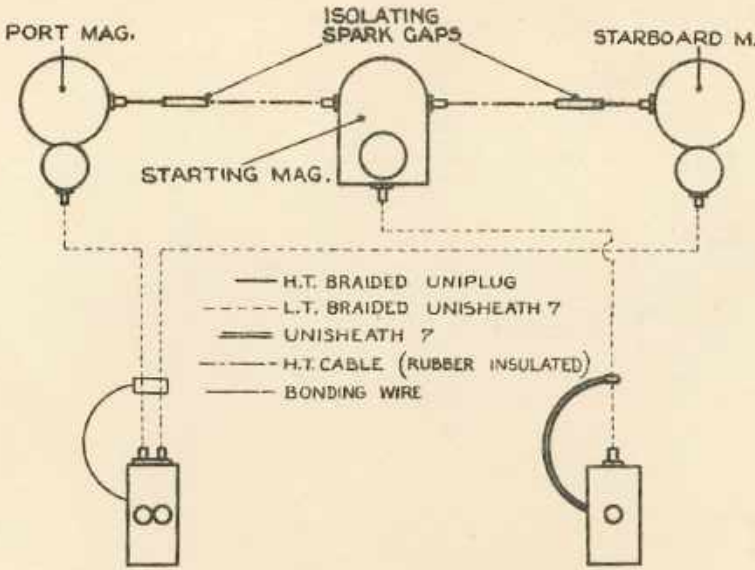


FIG. 10

RADIATOR FLAP CONTROL

FIG.11



IGNITION DIAGRAM

FIG.11

FIG.12.

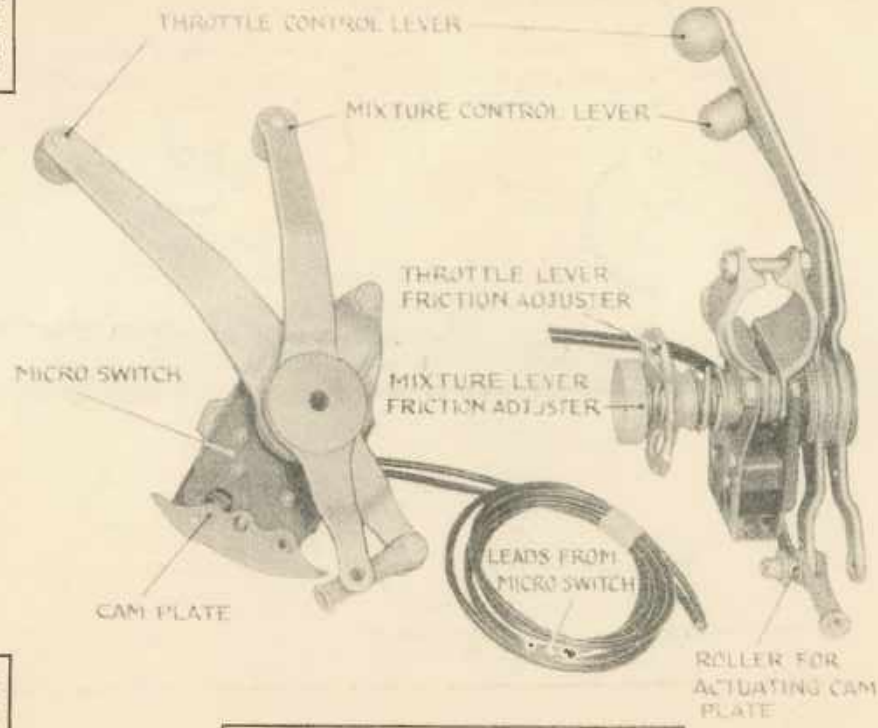
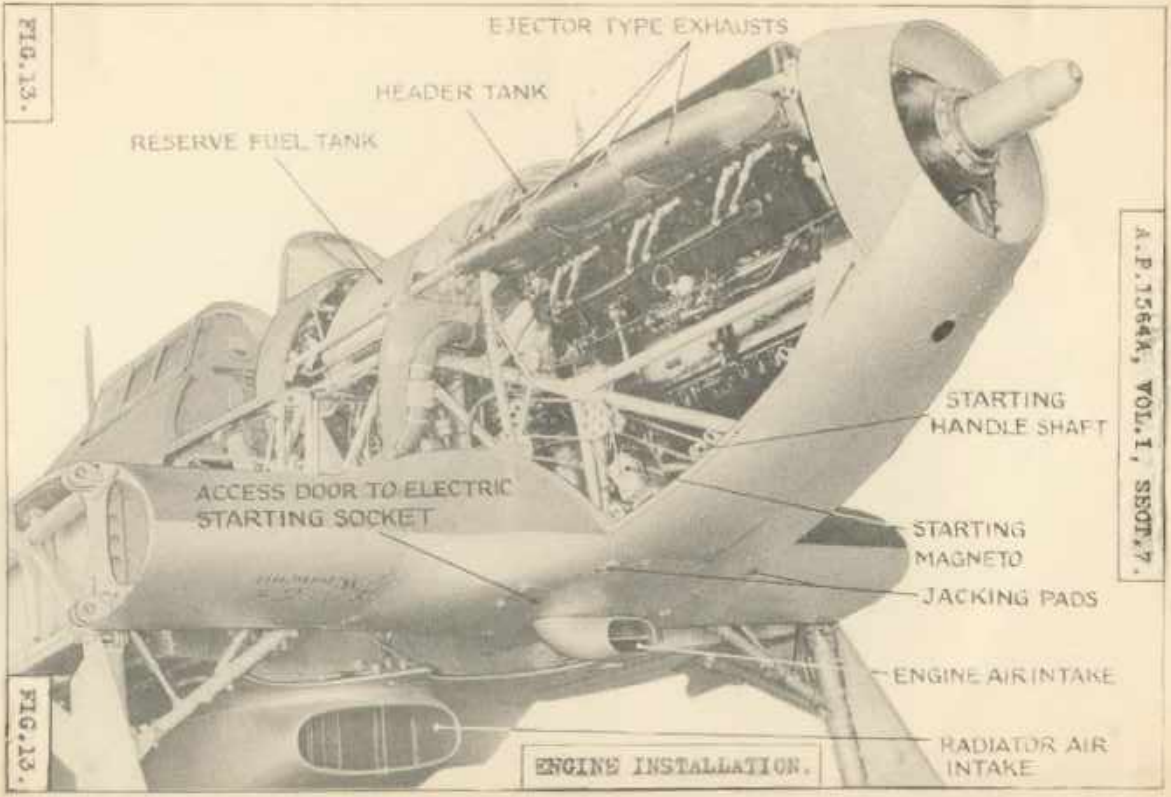


FIG.12.

THROTTLE AND MIXTURE CONTROLS.

FIG. 13.



ENGINE INSTALLATION.

FIG. 13.